PROCEEDINGS

OF THE

Hawaiian Entomological Society

VOLUME VIII

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PROCEEDINGS

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Hawaiian Entomological Society

VOL. VIII, No. 1 FOR THE YEAR 1931 NOV., 1932

JANUARY 8, 1931

The 300th regular meeting of the Hawaiian Entomological Society was held at the Experiment Station of the Hawaiian Sugar Planters' Association at 2:30 p.m., January 8th, 1931.

In the absence of the President and Vice-President, Mr. O. H. Swezey acted as chairman. Other members present were: Messrs. Au, Bryan, Ehrhorn, Fullaway, Ito, Keck, Rosa, Sakimura, Stanley, Van Zwaluwenburg, Wilder and Williams. Two visitors: Miss Dobroscky and Miss Suehiro.

The minutes of the previous meeting were read and approved.

The Chairman appointed Mr. Ehrhorn to audit the Society's accounts for 1930.

Mr. Bryan reviewed the list of common names of insects in Hawaii. The list, which is not yet final, induced considerable discussion.

Mr. Swezey spoke of the Trail and Mountain Club hike up Mt. Kaala on Sunday, January 11, as offering opportunity for entomologists.

Miss Dobroscky spoke of the New York Entomological Society, of which she has been a member since 1926.

PAPERS

"Thrips tabaci Imported From Oregon."*

BY K. SAKIMURA.

NOTES AND EXHIBITIONS

Megamelus proserpina Kirk.—Mr. Fullaway spoke of the taro leafhopper as being very abundant in a limited area in some of

* Not available for publication [Ed.]

the Waianae homesteads. The homesteaders complained of their ravages. All the female leafhoppers were the short-winged form.

Cremastus hymeniae Viereck.—Mr. Swezey reported as an addition to the list of hosts of this parasite *Genophantis leahi* Swezey, whose caterpillars feed on Euphorbia. He had collected four caterpillars on a Euphorbia bush in Iao Valley, Maui, Sept. 11, 1930. Two of these caterpillars yielded, each, one of these parasites.

Chrysopa lanata Banks.—A specimen of this lacewing fly was exhibited by Mr. Swezey, who had reared it from a larva found eating the eggs of *Spodoptera mauritia* on a leaf of *Ficus macrophylla* at the Kamehameha School grounds, Honolulu, Dec. 11, 1930. The larva grew rapidly, feeding on these eggs, and spun a white spherical cocoon Dec. 18. The adult issued Dec. 31. On two or three other occasions the larvae of this species have been found feeding on *S. mauritia* eggs. The larva does not cover itself with debris or insect remains.

Holcobius glabricollis Perkins.—Specimens of this ptinid beetle were exhibited by Mr. Swezey, who had reared twenty-one of them from a dead branch of koa tree from the planted koa forest on Sugar Loaf Hill, Nov. 4, 1930. From some of their larvae, specimens of a Sclerodermus were reared, which is apparently a new species.

Pseudococcus citricolus Green.—Mr. Ehrhorn spoke of finding a mealybug on a lime tree in Manoa Valley which has been identified as this species. It is the first record of its occurrence in the Hawaiian Islands.

Volucella pusilla Macquart.—Mr. Ehrhorn reported finding this species of syrphid fly very abundant on flowers of *Montanoa bipinnatifida,* in Manoa Valley, Dec. 21, 1930, in company with *V. obesa.*

Volucella pusilla Macq.—Dr. Illingworth also reported this recently introduced syrphid abundant, feeding on the flowers of Bidens in a vacant lot in Kaimuki, Dec. 12, 1930. This species was first discovered in the islands by Mr. J. S. Rosa Oct. 30, 1930, at Waipahu.

Dr. Gerrit Wilder reported on collecting a drowned specimen of this fly in swimming pool Nov. 20, 1930.

Volucella pusilla Macquart.—Mr. Bryan reported finding this new fly very abundant at the University of Hawaii campus, Dec. 6, about the blossoms of *Nothopanax cochleatum,* in company with *Lathyrophthalmus arvorum, Volucella obesa, Stomorhina pleuralis, Milichiella lacteipennis, Chrysomyia megacephala,* Pachodynerus wasps, and honey bees. The blossoms of Golden dewdrop (*Duranta repens*) near by, were attracting the honey bees and Pachodynerus wasps, but not the flies. The insects were eagerly sucking nectar from the opening blossoms.

Mr. Keck reported having seen what was undoubtedly this fly in September, 1930, on Chinese Orange in Honolulu.

Flies from Laysan Island.—Mr. Bryan exhibited specimens of four species of Diptera collected on Laysan Island by Gerrit P. Wilder, August, 1930. The species were:

Scatella sexnotata Cresson
Lucilia graphita Shannon
Undetermined sarcophagid
Undetermined stratiomyid

All four species have been previously recorded from Laysan, (Bryan, B. P. Bishop Museum Bulletin 31, 1926).

Cryptolaemus montrouzieri Mulsant.—Mr. Bryan exhibited a leaf of the Hawaiian wiliwili (*Erythrina monosperma*) from the University of Hawaii campus, having on it pupal cases of this ladybeetle, and the newly emerged beetles. The cases consist of the dry larval skins, which are white and waxy, much resembling the mealybugs on which the beetles prey.

Caryoborus gonagra Fabr.—Mr. Bryan reported finding this bruchid beetle in a flower of *Sesbania grandiflora* var. *coccinea,* December 6th, on the University of Hawaii campus.

Mylabris limbatus (Horn).—Mr. Bryan reported finding this bruchid beetle in the pods of *Wallaceodendron celebicum,* the banuyo legume, on the University of Hawaii campus, December 6th.

Mosquitoes in Hawaii.—Mr. Bryan stated that he had been told by Mr. David M. Forbes of Waimea, Hawaii, that in 1890, when

he, Forbes, had first gone to the Kukuihaele Plantation in Hamakua, Hawaii, there had been no mosquitoes in that region. He said that they had arrived a few years later, and had become quite abundant.

Mr. Forbes also related the following anecdote, which he had heard secondhand from an old Hawaiian living in Waimea, Hawaii, but which is at least suggestive as to human aid in insect distribution. The story goes that sometime about 1860, a sailor from some vessel anchored at Kawaihae had had a sweetheart living in Waimea. When it came time for him to leave, he gave her a parting gift to remember him by, with instructions that she was not to open it until his ship had put to sea. When she opened the little bag which the parcel contained, out jumped several little uku. And that is how the flea, which is still so abundant in the region, first came to Waimea.

Galleria mellonella (Linn.)—Dr. Wilder reported having reared this moth from comb in beehive, Dec. 3, 1930. Moth, cocoons and chrysalis were exhibited. The other bee moth, *Meliphora grisella* (Fabr.) was also reared at the same time. This appears to be the first record of *Galleria mellonella* in the Hawaiian Islands.

FEBRUARY 5, 1931

The 301st regular meeting of the Hawaiian Entomological Society was held at the Experiment Station of the Hawaiian Sugar Planters' Association, on February 5, 1931, at 2:30 p.m.

Members present were: Messrs. Bianchi, Bryan, Carter, Ehrhorn, Fullaway, Hagan, Illingworth, Marlowe, Mason, McBride, Mitchell, Rosa, Swezey, Van Zwaluwenburg and Williams. Visitors present: A. J. Smith and W. H. Volck.

President Mason called the meeting to order.

The minutes of the previous meeting were read and approved.

Mr. Ehrhorn stated that he had audited the Society's accounts for 1930 and found them to be correct.

Upon being called upon, Mr. Volck of the California Spray Chemical Company made a few remarks.

NOTES AND EXHIBITIONS

Engytatus geniculatus Reuter.—Dr. Illingworth reported this mirid bug feeding and breeding in the flowers of tomatoes at Kaimuki. Both nymphs and adults were observed in abundance sucking on the anthers of the flowers, causing these organs to dry up. As a result few of the fruits set. A mosaic disease was evident on the leaves of the plants, and also on peppers adjoining. As far as observed, these bugs were the only sucking insects present, and possibly are the vectors.

This led to a considerable discussion on insects as transmitters of yellows, mosaic and other virus diseases.

Haplogonatopus vitiensis Perk.—Mr. Swezey reported that twenty-six cocoons of this dryinid were collected from taro leaves at Waianae, January 13, where the parasite had bred on the taro leafhopper, *Megamelus proserpina* Kirk. From these cocoons, eight of the dryinid and thirteen *Saronotum americanum* Perkins had issued.

Cyrtorhinus mundulus (Bredd.).—Mr. Swezey reported this bug as occurring abundantly on the taro leafhopper in Waianae. There were adults, nymphs and also the eggs in the petioles of the taro. A Polynema issued from some of these eggs, apparently the same species (*reduvioli*) that has been reared from eggs of Reduviolus. Possibly there was a Reduviolus egg among the Cyrtorhinus eggs. *Reduviolus capsiformis* (Germ.) was observed on the taro.

Scelio sp.—Mr. Swezey exhibited numerous living examples of a Scelio reared from grasshopper eggs (Oxya sp.) received from Mr. Pemberton, sent from Serdang, Selangor, Federated Malay States. Five consignments of parasitized eggs had been received from Mr. Pemberton, and from them several hundred Scelio had issued, 600 of which have been liberated in favorable places for them to find Oxya eggs for oviposition. Others are being retained in attempts to rear them.

Protoparce quinquemaculata blackburni (Butl.).—A caterpillar of the Hawaiian tobacco worm was exhibited by Mr. Swezey. He had collected two of them on a tobacco plant growing wild at the mouth of Kaneana Cave, Makua, Oahu, January 25, 1931. This insect has seldom been collected on Oahu, though quite common

on Maui and Molokai. It was the first time that he had collected it on Oahu.

Oopsis nutator (Fab.)—Mr. Swezey reported having reared nine of this longicorn beetle from a dead Pipturus tree from Manoa Valley, Dec. 28, 1930. It apparently had not been recorded from that tree previously. Previous records have been from hau and kukui.

Aneristus ceroplastae How.—Mr. Swezey reported this aphelinid from *Coccus hesperidum,* from which apparently it had not been previously recorded in Hawaii. Sixty of the parasites had issued from a small infestation of *Coccus hesperidum* Linn. on papaia fruit. The material had been handed in Jan. 12 by Mr. Ehrhorn, who had received it from Mr. Ambrose of the Kamehameha Schools. The papaia had grown on the Kamehameha school farm in Hahione Valley near Koko Crater.

Aenasia sp.—Mr. Fullaway exhibited specimens of *Aenasia* sp., parasitic on the pineapple mealybug. He spoke of this encyrtid and the Mexican hemerobiid, sent in by Mr. Rust, as being to all appearances now established here. He exhibited also a Hippoboscid fly, an ectoparasite on pheasants here. The taro leafhopper Megamelus at Waianae was also mentioned and rather widely discussed. Mr. Swezey added that *Cyrtorhinus mundulus,* the egg-sucking bug of the sugar cane leafhopper, occurred in all stages among these taro leafhoppers, upon the eggs of which it undoubtedly fed. Mr. Fullaway further mentioned finding the lady beetle *Curinus coeruleus* resting on the fruit of noni (*Morinda citrifolia*) at Waianae, and Mr. Bryan spoke also of finding this beetle resting in groups. Its host did not appear to be present in either case.

Mr. Bryan spoke of a fine relief map of Oahu, the work of Mr. Haas, Government engineer, as being on exhibit at the Bishop Museum. Here also was mentioned the fact that *Nesithmysus haasii,* a rare and handsome native longicorn beetle, was named in honor of Engineer Haas, its discoverer.

At Dr. Carter's invitation, Monday, Feb. 9, at 4:00 p.m., was set aside for an entomological visit to the new virus building of the Association of Hawaiian Pineapple Canners.

The Executive Committee announced the appointment of the following officers for 1931:

O. H. Swezey—Editor.
J. S. Rosa—Librarian.
F. X. Williams—Curator of Collections.

MARCH 5, 1931

The 302nd regular meeting of the Hawaiian Entomological Society was held at the Experiment Station of the Hawaiian Sugar Planters' Association, on March 5, 1931.

Members present as follows: Messrs. Bianchi, Bryan, Ehrhorn, Fullaway, Hagan, Keck, Mason, McBryde, Rosa, Swezey, Van Zwaluwenburg, Watt, Weinrich, Wilder, Willard, and Williams.

President Mason called the meeting to order.

The minutes of the previous meeting were read and approved.

NOTES AND EXHIBITIONS

Mr. E. H. Bryan gave a very interesting talk (to be published elsewhere in detail) on his recent visit to the barren island of Kahoolawe, from Feb. 13-19. He made extensive collections of plants and insects and took many photographs. A strong wind sweeps over the island. Two boxes of Kahoolawe insects were shown. Much discussion intervened and followed.

Coptotermes formosanus Shiraki.—Mr. D. T. Fullaway spoke of the spread of this termite to Lanai landing.

Draeculacephala mollipes (Say) on Maui.—Mr. Van Zwaluwenburg reported seeing an adult of this species on grass at Olowalu, Maui, Feb. 19, 1931. This appears to be an addition to its known distribution in these Islands.

Heterocrossa olivaceonitens Walsm.—A series of thirty-seven of this pretty green-marked moth was exhibited by Mr. Swezey who had reared them from about three dozen Sideroxylon fruits picked up in the dry stream bed in Makaleha Valley, Waianae Mts., Feb. 1, 1931. It has previously been reared from the same fruit from various places on Oahu, and also from Clermontia buds and fruit. It occurs also on Kauai, Maui and Hawaii.

Litomastix floridana (Ashm.)—Mr. Swezey exhibited a caterpillar of *Plusia chalcites* parasitized by this tiny parasite, which had been collected on *Solanum nodiflorum,* a weed in a fallow pineapple field on Kunia road Feb. 19, 1931. This is the farthest from Honolulu that this parasite has been recovered.

Aphis middletonii Thomas.—Mr. Swezey reported finding this root-inhabiting aphis on roots of *Bidens pilosa, Solanum nodiflorum* and *Elusine indica* in fallow pineapple fields of Waipio and Kunia, Feb. 19, 1931. These are new host-plant records for this aphid in the Hawaiian Islands.

Dr. Williams reported on two immigrant Psocidae identified by Nathan Banks in 1930. These are:

Psocathropus lachlani Ribaga, taken in 1927 and 1928 in Honolulu by O. H. Swezey; and *Psoquilla marginepunctata* Hag., taken in 1918 in Honolulu by O. H. Swezey and in 1925 at Kualoa, Oahu, by G. A. McEldowney. To quote, in part, Mr. Bank's letter of Aug. 6, 1930: "There are two very good things both described from Europe in hothouses; the Psoquilla has been found in various parts of the tropics, the Psocathropus in Italy, Africa and now with you; a very similar form is in Florida".

Pantala flavescens (Fab.)—Dr. Williams also exhibited two living nymphs of our common dragon fly. These nymphs are often abundant in very shallow water of ditches and marshes where the temperature feels almost tepid to the touch. He called attention to their protective coloration. They breathe by means of rectal gills.

Ethmia colonella Walsm.—This moth, that defoliates the native "Kou," *Cordia subcordata* Lam., was discussed and the question arose that, since one now seldom sees large specimens of this "Kou", whether Ethmia was not responsible for the commonly stunted condition of these trees and if it was not to be considered an introduced insect.

Mr. Swezey spoke of having received a publication in German on the life of Albert Koebele.

The subject of a picture of the late Mr. W. M. Giffard came up and Mr. G. P. Wilder kindly volunteered to procure one, if possible, for the Society.

APRIL 2, 1931

The 303rd regular meeting of the Hawaiian Entomological Society was held at the Experiment Station of the Hawaiian Sugar Planters' Association, on April 2, 1931, at 2:30 p.m.

Members present as follows: Messrs. Bryan, Carter, Chapman, Ehrhorn, Fullaway, Ito, Keck, Mason, Rosa, Sakimura, Van Zwaluwenburg and Williams.

Visitors: Dr. Irene D. Dobroscky, Miss Amy Suehiro and Mr. T. M. Blackman.

President Mason called the meeting to order.

The minutes of the previous meeting were read and approved.

Dr. Wilder mentioned having secured a photograph of the late Mr. W. M. Giffard.

PAPERS

Mr. D. T. Fullaway read the titles of two papers now in preparation by him—as follows:

"Synopsis of the Hawaiian Diaspinae."

"Hymenopterous Parasites of Coccidae, etc., in Hawaii."

Dr. Williams read by title a paper by J. Meikle Brown—as follows:

"A New Species of Proisotoma (Order Collembola) from India."

NOTES AND EXHIBITIONS

Nesithmysus haasii Perkins.—A fine specimen of this cerambycid beetle was exhibited by Mr. Swezey who had reared it from a larva found in a *Pelea clusiaefolia* tree on the U. S. Engineers' trail from Wahiawa to Waikane. The locality was just over the crest on the Waihawa side of the Koolau Range, and probably within a mile of where the type specimen was collected on the same trail July 4, 1920. The only other specimen ever collected was by Dr. Williams, July 21, 1929, on the top of Mt. Kaala. This is the first time it has been reared, and determines its host tree to be Pelea, the same as for all of the other species of Nesithmysus that are known.

Two specimens of *Nesithmysus bridwelli* Perkins were reared also from grubs obtained in the same tree as the above.

Oxacis collaris Shp.—A specimen of this oedemerid beetle was exhibited by Mr. Swezey, who had collected it from a young cane shoot at Kawela, Molokai, Mar. 23, 1931. The first record of its occurrence on that Island.

Ananca sinensis Gemm. (?)—A specimen of this oedemerid beetle was exhibited by Mr. Swezey. He had collected it at light at Mapulehu, Molokai, Mar. 21, 1931. The first record of its capture on Molokai.

Kelisia paludum Kirk.—A specimen of this delphacid leafhopper was exhibited by Mr. Swezey, who had captured it in swamp (swept from a small sedge) at Mapulehu, Molokai, Mar. 20, 1931. Several nymphs were also obtained. It is the first record of its occurrence on Molokai.

Lathyrophthalmus aeneus (Scop.) — Mr. Swezey reported catching one of these syrphid flies at light at Mapulehu, Molokai, March 21, 1931. It is the first record of its occurrence on that Island.

Mr. E. H. Bryan, Jr., exhibited some beetles from New Guinea.

Virus diseases—chiefly on plants, were discussed by Drs. Dobroscky, Chapman, Carter, Messrs. Fullaway and others.

Dr. Carter reported on the long-postponed virus trip that took place on February 19. It was replete with interesting discoveries re mosaic and other diseases on various weeds. Considerable discussion followed. Only five persons (all entomologists) went on this trip.

Following a discussion on the corn ear worm (*Heliothis obsoleta*) which has done much damage to corn here during the last year, Mr. Fullaway spoke of the larger quantities of fresh vegetables coming from the Pacific coast in recent years and hence the danger from insect pests from these sources.

Acting upon a motion made at the beginning of the meeting by Mr. Fullaway and seconded by Mr. Bryan, that a committee be appointed to secure and assemble photographs of members of the Hawaiian Entomological Society, particularly of the older members, President Mason appointed Messrs. Ehrhorn, Fullaway and Swezey as the members of that committee.

MAY 7, 1931

The 304th regular meeting of the Hawaiian Entomological Society was held at the Experiment Station, H.S.P.A., on May 7, 1931, at 2:30 p.m.

Members present as follows: Messrs. Bryan, Crawford, Ehrhorn, Fullaway, Hagan, Illingworth, Keck, Mason, Mitchell, Rosa, Swezey, Van Zwaluwenburg, Wilder and Williams.

Visitor—Mr. T. M. Blackman.

President Mason called the meeting to order.

The minutes of the previous meeting were read and approved.

Mr. Swezey announced that the Proceedings of the Hawaiian Entomogolical Society VII, No. 3, for the years 1929-1930 were now published and available.

Mr. Bryan presented a MS. of the index for Vol. VII, of the Proceedings. The Society expressed its appreciation of the work of Editor O. H. Swezey and Mr. E. H. Bryan, Jr., for their painstaking work.

Mr. Bryan presented the Society with a large container for photographs of members of the Society.

PAPERS

Mr. Swezey presented a paper entitled

"The Host Trees of the Endemic Cerambycidae in Hawaii" and gave a brief résumé of it.

On behalf of Dr. F. Muir he presented a book review entitled **"The Biological Control of the Coconut Moth** (*Levuana iridescens* Beth-Baker) **in Fiji,"** by Messrs. J. D. Tothill, T. H. C. Taylor and R. W. Paine.

NOTES AND EXHIBITIONS

Enchytraeus silvestris Bretsch.—Mr. Swezey reported that he had recently received a card from Dr. Michaelsen, of Hamburg, giving this as possibly the name of a tiny worm sent him. The worms were from soil about seed cane, Puunene, Maui. They also were in the decaying seed cane and rotten leaf sheaths attached.

Heterocrossa atronotata Walsm.—A specimen of this moth was exhibited by Mr. Swezey, who had reared it from a larva collected on leaves of Vaccinium, Puu Kalena, Waianae Mountains, April 19, 1931. The species was described on a single specimen from the top of Haleakala, Maui, and this is the first time it has been collected since. It is very close to *H. inscripta,* which has been reared from Ohelo berries (*Vaccinium reticulatum*) at Kilauea, Hawaii.

Gitonides perspicax Knab.—Mr. Swezey reported rearing this fly from Cenchrus grass infested with *Trionymus insularis* collected at Kanoa, Molokai, April 27, 1931. It had not previously been recorded from Molokai.

Marietta graminicola Timb.—Mr. Swezey reported rearing this secondary parasite from *Trionymus insularis* Ehr., swept from Bermuda grass at Mapulehu, Molokai, March 20, 1931. The parasite issued April 17. It had not been recorded from Molokai previously.

Nesithmysus haasii Perkins.—A series of 12 of this cerambycid beetle was exhibited by Mr. Swezey, who had reared them from larvae in Pelea trees collected at the top of the ridge above Kahana Valley, February 9, 1931.

Hyposmocoma n. sp.—Mr. Swezey exhibited two moths that had issued from cases amongst lichens on koa tree, Tantalus. Miss Suehiro sent them in for exhibition. The larval cases were covered with bits of the lichen so as to resemble a part of the much-branched lichen to which they were fastened. The species is apparently undescribed, and related to *nigralbida* from Kauai.

Cryptorhynchus mangiferae (Fab.).—Mr. Swezey reported having found a larva of this weevil in seed of mango at Kawela, Molokai, April 27, 1931. It is apparently the first record of this insect on Molokai.

Mr. Bryan spoke of Prof. J. Chester Bradley's "Manual of Beetles of North America" as a very useful book. It is lithoprinted.

Ceratitis capitata Wied.—Dr. Illingworth said that at the present time fruit flies were quite bad. Mangoes particularly were affected. Host immunity was discussed by several of the entomologists present.

Anagyrus sp.—Dr. Williams said that the Anagyrus wasp, parasitic on the pink sugar cane mealybug and sent from the Philippines by F. C. Hadden was established, having been recovered from mealybugs on cane at the Honolulu Plantation Company on April 16 by Mr. Swezey and himself, and also recently recovered on cane at the H.S.P.A. Experiment Station grounds.

The flights of termites were discussed by Mr. Ehrhorn and others.

JUNE 4, 1931

The 305th regular meeting of the Hawaiian Entomological Society was held at the Experiment Station, H.S.P.A., on June 4, 1931, at 2:30 p.m.

Members present: Messrs. Bryan, Carter, Ehrhorn, Fullaway, Illingworth, Marlowe, Mason, McBride, Pemberton, Rosa, Swezey, Wilder and Williams.

Visitors: A. J. Smith, T. M. Blackman, Amy Suehiro.

President Mason called the meeting to order.

The minutes of the previous meeting read and approved as corrected.

The Secretary reported a meeting of the Executive Committee held on May 26 at 2:30 p.m., all the members of the Committee being present. The bill for $892.00 for publishing Vol. VII, No. 3, 1929-1930 of the Proceedings of the Hawaiian Entomological Society was discussed and Mr. Fullaway made a motion, seconded by Dr. Chapman, that the Society pay $250.00 from its funds toward defraying this bill. The motion was passed. An item for $16.00 for separata was also approved.

The Secretary then presented resolutions in regard to the death of Dr. F. A. G. Muir.

"*WHEREAS,* in the death of Dr. F. A. G. Muir, at his home in England, on May 13, 1931, the Hawaiian Entomological Society has lost one of its most devoted members, and

"*WHEREAS,* Dr. Muir, one-time president of the Society, taking the deepest interest in its welfare, faithful in attendance at the meetings, always ready to participate in the discussions, and

DR. FREDERICK A. G. MUIR

contributing valuable papers for publication in the Proceedings, and

"WHEREAS, he has always had the keenest interest in the furtherance of knowledge of the Hawaiian insect fauna, and in addition, being a world authority on the Fulgoroidea, as well as possessing a wide knowledge in other departments of entomology, while in his official capacity he has by his notable discoveries and importations of insect enemies of pests of the sugar cane, saved the sugar planters of Hawaii from great losses, *therefore*

"BE IT RESOLVED, that the Hawaiian Entomological Society hereby expresses its appreciation of his interest and participation in its affairs and his valuable work for the sugar industry, and records the grievous loss it has suffered in the passing of Dr. Muir, and

"BE IT FURTHER RESOLVED, that a sketch of Dr. Muir's participation in entomology in Hawaii be prepared for publication in the Proceedings of the Society, and that a copy of these resolutions be sent with our expression of deep sympathy to the bereaved family".

Dr. Wilder moved that these resolutions be adopted and placed on the minutes of the meeting. Seconded by Mr. Swezey and passed, and it was voted that a signed copy of these resolutions be sent as a message of condolence to Mrs. Muir. This was done.

Mr. Swezey offered to supply a biographical sketch of Dr. Muir. (See page 141 of this issue.)

Dr. Illingworth nominated Mr. Arthur J. Smith, 2468 Kuhio Street, for membership in the Society.

President Mason nominated Mr. T. H. Hong and K. H. Lau, both of the Entomological staff of the U. S. Department of Agriculture here, for Junior membership.

NOTES AND EXHIBITIONS

Mr. Bryan read a letter from Mr. Adamson which showed the progress in the Entomological survey of the Pacific.

Mr. Pemberton gave an interesting account of his experiences in Malaya.

Dr. Carter outlined, by the help of a Latin square diagram, an

experiment in thrips control for yellow spot disease in a pineapple area of eight acres. Dusting with tobacco gave 70% control.

Mr. Swezey mentioned nereid worms—ordinarily marine organisms—being found in some decayed taro at Punaluu. They were not considered to be the cause of the decay.

Mr. Ehrhorn gave, in part, a résumé translated from a German paper, on the life of Albert Koebele.

Coccotrypes dactyliperda (Fab.)—Mr. Swezey reported having collected this scolytid at Kohala, Hawaii, where it was boring in the seeds of a palm at the Kohala Club, May 13, 1931. He also collected it at Olaa, Hawaii, May 20, 1931, where it was boring the seeds of *Dictyospermum album* and *Livistona chinensis*. These were the first records of the occurrence of this beetle on the island of Hawaii.

Enochrus nebulosus (Say).—Dr. Williams exhibited this common hydrophilid beetle found in shallow water of the lowlands. It had been determined by Dr. Van Dyke as *Enochrus nebulosus* (Say), a widely distributed species. It seems first to have been taken here in 1914 by Mr. Swezey, but had remained unidentified until May, 1931.

JULY 2, 1931

The 306th regular meeting of the Hawaiian Entomological Society was held at the Experiment Station, H.S.P.A., on July 2, 1931, at 2:30 p.m.

Members present: Messrs. Bianchi, Bryan, Chock, Ehrhorn, Hagan, Illingworth, Keck, Mason, McPhail, Mitchell, Pemberton, Rosa, Van Zwaluwenburg, Wilder, Williams and Weinrich.

Visitor: Miss Amy Suehiro.

The minutes of the previous meeting were read and approved.

Arthur J. Smith, T. H. Hong and K. H. Lau were duly elected to membership.

Dr. Illingworth made a motion, seconded by Mr. Pemberton, that the bill of $189.45 for printing the thirty-two page Index for Vol. VII of the Proceedings of the Hawaiian Entomological Society be paid.

Mr. Van Zwaluwenburg made a motion, seconded by Mr. Ehrhorn, that the Secretary, in behalf of the Society, be instructed to write a letter of thanks to the trustees of the Hawaiian Sugar Planters' Association for their valuable financial aid in the publishing of Vol. VII, Proceedings of the Hawaiian Entomological Society.

Dr. Hagan gave an interesting account of the meeting in June, at Pasadena, of the Pacific Slope Branch of the American Association of Economic Entomologists.

NOTES AND EXHIBITIONS

Euscepes batatae Waterhouse.—Mr. Bryan exhibited specimens of this sweet potato weevil from a giant native specimen of sweet potato, u'ala, of the variety Mauna Pohaku, which weighed 16 pounds when fresh, grown by J. W. Kauwenui, at Laupahoehoe, Hawaii. The sweet potato was brought to B. P. Bishop Museum, July 2, 1931, by E. S. C. Handy.

Samoan insects.—Mr. Bryan exhibited three trays full of Samoan Orthoptera and Coleoptera, which were part of a collection made by D. T. Fullaway on the island of Tutuila, in February and March, 1930. The specimens had been mounted, labelled, sorted into groups, and many of the species identified, by Miss Amy Suehiro of the Pacific Entomological Survey Staff, at Bishop Museum.

Tachysphex fusus Fox.—Dr. Williams exhibited a fresh specimen of this little larrid wasp, that has the tip of the abdomen reddish. It was caught on the margin of Field 4 B, Waianae Sugar Plantation, Oahu, on June 5, 1931. This insect is common and widespread in the United States, where it provisions its shallow burrows, made in soil, with the young of short-horned grasshoppers. As the sugar cane grasshopper (*Oxya chinensis*) is abundant in parts of Waianae, the wasp probably preys on it.

Chalybion caeruleum (Linn.)—Dr. Williams exhibited a large fresh male specimen of this brilliantly steel-blue sphecid wasp taken June 8, 1931, at a lanai (porch) window in Woodlawn, Honolulu. It uses the cells of Sceliphron (black and yellow mud-daubers) for its nest, storing them with spiders. It is common in the United States.

Telmatoscopus albipunctatus (Will.).—Dr. Williams reported on the identification of this large psychodid fly that holds its wings flat or horizontally. It was first taken about Honolulu in 1929 and where it is now common. Its early stages are passed in water or very wet mud, in tree holes, etc. This fly was sent to Dr. Guy Marshall, for identification, who writes that it is widely distributed in the Tropics. It was described in 1893, as *Psychoda albipunctata* Williston from Havana, Cuba.

Philippine weevils in the fruits of wild figs.—Dr. Williams exhibited a collection of weevils which had been referred to Dr. Marshall for identification, and had been determined chiefly by Dr. Heller, an authority on this group. The weevils are mostly of the genus Balaninus, but the genera Metarchus, Pleurotyges, Tropibalaninus and Mecopus were also represented.

There were fifteen species of these weevils in the collection.

Agrion.—Dr. Williams exhibited also a specimen of a damsel fly which passed through its life-cycle in almost exactly three months. The egg was secured in a stream on Tantalus.

JULY 27, 1931

A special meeting of the Hawaiian Entomological Society was held at the H.S.P.A. Experiment Station at 3:00 p.m., July 27, 1931, in honor of Dr. F. S. Bodenheimer, visiting from Palestine.

Members present: Messrs. Bianchi, Bryan, Carter, Chapman, Chock, Hong, Illingworth, Ito, Keck, Mason, McBride, McPhail, Mitchell, Pemberton, Sakimura, Van Zwaluwenburg, Weinrich and Williams.

Visitors present: Dr. Bodenheimer, Mrs. Cassidy, Messrs. Lau and Kamito, and Miss Suehiro.

President Mason called the meeting to order.

Dr. Bodenheimer gave a very interesting talk on the principles of population movements among insects—what caused epidemics among insects and what suppressed them. This centered in a study of insects in relation to their environment—Ecology.

The factors limiting insect life were considered. Physical factors were here generally considered more effective than control by predators and parasites.

Generally speaking, food supply is not the real limiting factor —as there is usually more than enough for all. Nor is struggle for existence thus effective, because insect mortality is heaviest in the early stages—before there would be competition.

As regards parasitism, at least in countries with well-marked seasons—there is a heavy winter mortality among insects, and parasites must make a new start each year—hence there would be no cumulative effect on pests from year to year.

Climatic factors—Temperature and humidity were considered as having the overwhelming influence on the control of insect life. Insects are killed in the stage where tolerance is least—this is usually in the early stage of existence. The eggs of a Schistocerca grasshopper, for example, present a high mortality while the young hoppers themselves are very tough. This showed the importance of careful life-history studies for the understanding of epidemics. A sigmoid curve showing first a slow increase, then a rapid increase, finally a uniform population density level—where nevertheless food might be in plenty, but fertility was lowered, demonstrated very well the proper point at which a pest showing this population curve would best be controlled.

A number of problems were considered:

(1) The relative fertility of a certain insect (e.g., a coccid) on different food plants.

(2) Host resistance—sometimes obvious, e.g., hairiness, hardness, smothering sap, oil cells.

(3) Biological resistance—Host must be suitable, else parasite perishes, e.g., host leucocytic action on parasite eggs. Much parasite mortality. Here it was pointed out that a hundred parasitized caterpillars, for example, represented not one hundred, but probably several hundred parasite eggs laid to effect this parasitism.

Parasites produce biological equilibrium.

Dr. Bodenheimer gave his impression of conditions in Hawaiian economic entomology—due largely to the lack of well-marked seasons, parasitic control was here especially good. He advised strongly that more and systematic study be given the part nutrition, climate, parasites and other factors play in insect control; in other words to make epidemiological analyses here.

By this method the effect and degree of parasitism here would be best understood.

Theoretical possibilities in relation to pests and parasites in Hawaii were stated:

(1) If the host and its parasite have the same climatic tolerance there will result a cumulative parasitism.

(2) If the parasite has the better climatic tolerance the parasitism will be better.

(3) Outbreaks are rare here, perhaps on account of the rare climatic oscillations—fluctuations of insect abundance would still be less.

(4) As regards the fruit fly, there is a possibility of the existence of an optimum center of parasitism.

Dr. Bodenheimer concluded with photographs of identical objects taken through the lens of a butterfly and of man; those taken through the human lens gave the better, more detailed image.

On behalf of the Society, President Mason thanked Dr. Bodenheimer for his very instructive talk.

AUGUST 6, 1931

The 307th regular meeting of the Hawaiian Entomological Society was held at the Experiment Station, H.S.P.A., on August 6, 1931, at 2:30 p.m.

Members present: Messrs. Au, Bryan, Carter, Chapman, Chock, Hagan, Hong, Illingworth, Ito, Keck, Lau, Mason, McBride, McPhail, Mitchell, Pemberton, Smith, Stanley, Van Zwaluwenburg, Sakimura, Weinrich, Whitney and Williams.

Visitors: Messrs. H. P. Agee, L. O. Howard, Hoffman, Kamito, le Roux, Riley, Silva, Vaughan and Amy Suehiro.

President Mason called the meeting to order.

The minutes of the preceding regular meeting were read and approved, and reference was made to the special meeting of July 27, in honor of Dr. Bodenheimer.

The meeting was concerned mainly with the distinguished visitors present.

Dr. L. O. Howard spoke of the importance in publishing one's observations, even though they be fragmentary. From such, future

biological conclusions might be derived. The Entomological Society of Washington is also publishing such notes. He also gave entomological news items from Washington, D. C.

Dr. Wm. A. Hoffmann, who is stationed at Lingnan University in China and who is much interested in aquatic Hemiptera said that there are about fourteen biological journals in China, of which a large proportion were commenced during the last two years. The new species are described in readable language in such journals.

Dr. Wm. A. Riley of the University of Minnesota and now on his way to China made some observations on medical zoology and entomology.

Dr. A. Kamito, a government entomologist in Tokyo, Japan, exhibited some insect pests of rice in Japan and some of the parasites of such pests.

Mr. Pemberton exhibited a specimen of the small bethylid wasp, *Holepyris hawaiiensis,* several of which had recently stung persons in Honolulu, with rather unpleasant effects.

Some varied discussion followed.

SEPTEMBER 3, 1931

The 308th regular meeting of the Hawaiian Entomological Society was held at the Experiment Station, H.S.P.A., at 2:30 p.m. on September 3, 1931.

Members present: Messrs. Bianchi, Bryan, Carter, Hagan, Hong, Illingworth, Keck, Mason, Marlowe, Mitchell, Pemberton, Rosa, Smith, Swezey, Van Zwaluwenburg and Williams.

Visitors: Thos. G. Eckart and Miss Amy Suehiro.

President Mason called the meeting to order.

Mr. Van Zwaluwenburg made reference to the outline of study of Insect Ecology that was given him by Dr. Bodenheimer and stated that it could be mimeographed for distribution among the entomologists here. Dr. Carter moved this be made a motion; it was seconded by Dr. Hagan and passed.

Mr. Bryan proposed the name of Prof. Olsen, teacher in Entomology at the University of Hawaii, for membership.

President Mason spoke of the dinner and informal meeting

of the Hawaiian Entomological Society held the evening of August 19, at the Blaisdell Hotel, in honor of Dr. L. O. Howard. Forty-eight persons were present—members and their wives and visitors, including Dr. L. O. Howard, Col. Chas. E. Davis and Dr. Akira Kamito. An enjoyable evening was had by all.

PAPERS

Mr. Pemberton gave a paper entitled **"Irritation Caused by the Sting of the Bethylid Wasp,** *Holepyris hawaiiensis* Ashm."

Mr. Van Zwaluwenburg, on behalf of Dr. E. Fleutiaux, presented two papers, one on descriptions of **New Melasid beetles,** and the other on **New Elaterid beetles.**

NOTES AND EXHIBITIONS

Mr. Swezey remarked on the meeting at Pasadena, in June, of the Pacific Slope Branch of the American Association of Economic Entomologists which he attended. About one hundred and seventy members were present. He spoke of the fine work done by the chalcid parasite *Coccophagus guerneyi* on the citrophilus mealybug; of the earwig parasites, in Oregon; of the evolution of a soil sifter; of the importance of commercial work in entomology; of the bean thrips quarantine; and of the enjoyable collecting excursions, after the close of the meeting.

Dr. Carter mentioned burning on Kailua watermelon vines produced by the little jassid leafhopper Empoasca. Bordeaux mixture—regarded as an insect repellent—was taken up by this cucurbit an then sucked up by the leafhopper with deleterious results to the latter.

Kamehameha Butterflies and Koa trees.—Mr. Bryan reported that Mr. E. L. Caum had related the experience of finding the large gray click beetle, *Chalcolepidius erythroloma* Candèze, on a koa branch, and around the white, semicrystalline, hardened sap, which had exuded from the injury it had made, a semicircle of seven Kamehameha butterflies, each with the tip of its proboscis between the head of the beetle and the hardened sap, apparently sipping the sap. This observation was made on July 18th, in the Land of Haukulu, upper Manoa Valley, on the Pauoa side of the valley.

Dr. Illingworth spoke of observing the clean-up by a fungus of the green coffee scale on Gardenia.

Polycaon stouti (Lec.).—Mr. Van Zwaluwenburg reported that a mutilated adult of this bostrichid beetle collected at Puunene, Maui, was received August 20 from Mr. F. W. Broadbent. It was found boring in a piece of furniture which had been imported from the Pacific Coast in November, 1929. The species is a native of Oregon, California and Arizona, attacking dead eucalyptus, etc., and occasionally living trees. It is sometimes a pest of cured hard woods. The only other specimen recorded from these Islands is one that issued from a table top in Honolulu in 1922.

Probable Type-Locality of Simodactylus tastui (Le Guill.).—Mr. Van Zwaluwenburg stated that Schenkling (1925, Junk's Coleopterorum Catalogus, part 80, p. 101) incorrectly gives the habitat of the Polynesian elaterid beetle *Simodactylus tastui* (Le Guillou) as Hawaii. The species is not known, or elsewhere recorded, from the Hawaiian Islands.

Candèze (1859, Mon. des Elat., II, p. 152) says of this species that Le Guillou "fait a connaitre . . . un insecte de Hamoa, l'une des isles de l'archipel des Amis . . . ". Friendly Islands was Capt. Cook's name for the Tonga group. Search of all available literature, including Dr. W. T. Brigham's Index to the Pacific Islands, fails to disclose any such island name in the Tonga, or any other, group of Pacific islands.

However, as pointed out by Mr. E. H. Bryan, Jr., and Dr. Peter Buck of the Bishop Museum, many South Pacific islands lack an "S" in their language, and in place of it use an "H". Savaii of the Samoa group, for example, is identical with the name Hawaii. It therefore seems probable that *Simodactylus tastui,* which is not an Hawaiian insect so far as known, is really a Samoan species.

A new immigrant Elaterid beetle.—Mr. Van Zwaluwenburg reported that on the evening of August 18, 1931, Mrs. R. H. Van Zwaluwenburg, in a house on Lanihuli Drive, Manoa, Honolulu, captured an Elaterid adult at light, which from its size (16.0 mm.) was at first mistaken for the common Simodactylus present here. Examination shows it to be a Monocrepidius, dis-

tinct, however, from *M. exsul* Sharp. It is very close to an unnamed specimen from Queensland in the H.S.P.A. collection, and it may be an Australian species. A second specimen (a male) was taken August 26 near Diamond Head, Oahu, by Mr. Pemberton.

A First Record of the Coleopterous Family Scydmaenidae in Hawaii.—Mr. Van Zwaluwenburg reported that two minute beetles taken by himself in August, 1930, in soil in the forest on Tantalus, Oahu, at about 1200 feet, have been determined by Mr. G. E. Bryant, of the British Museum, as *Cephennium* sp., "not in British Museum". This genus belongs to the family Scydmaenidae, a family apparently not recorded from the Territory heretofore. The genus Cephennium Müll. and Kunze, according to part 70, Colepterorum Catalogus, by E. Csiki, contains 94 species, mainly European and North African, with four species recorded from North America, two from Singapore and one from Ceylon. The species from Tantalus definitely is not the single species recorded from California, which is described as eyeless.

Systole geniculata Först.—The rearing of numerous specimens of this seed-chalcid from fennel seeds collected near the polo field on central Maui, July 6, 1931, by Mr. O. H. Lyman, was reported by Mr. Van Zwaluwenburg. Previously reported from Oahu and Hawaii, this is the first time this species has been obtained from Maui.

Macranillus atomus Jeannel.—Paratype specimens of this newly described minute Carabid received from Dr. G. A. K. Marshall were exhibited by Mr. Van Zwaluwenburg. These specimens were taken in cane-soil studies on Oahu, averaging 13 per square foot (to a depth of 9 inches) and being most numerous between 5 and 9 inches, in both growing-cane soil and fallow soil. Their minute larvae are fairly numerous in the lower soil depths.

The genus Macranillus was erected by Sharp (1903-Fauna Hawaiiensis, III, p. 287) based upon *M. coecus* Sharp, (a unique) from the high plateau on Kauai. Macranillus is separated from Nesomicrops by reason of having the eyes not pigmented or faceted, but represented by two small, smooth, slightly raised areas.

Mr. Pemberton spoke of the present scarcity of *Omiodes blackburni,* the coconut leafroller on Oahu. A discussion of its parasites followed and *Cremastus hymeniae* was regarded as probably one of its checks.

President Mason said that two fruit fly parasites had just been sent from Hawaii to California as possible parasites on the walnut husk maggot.

Dr. Williams on behalf of Mr. Weinrich, who was unable to attend the meeting, presented a note on *Stapelia gigantea,* an African asclepiad plant with a large malodorous flower which attracted blowflies and induced them to deposit their young on it. Reference was also made to the papaya fruit fly, an American insect not found in Hawaii.

Holochlora japonica Brunn.—Dr. Williams reported this large green locustid as quite abundant on August 9, 1931, at the edge of Poamoho forest reserve at an altitude of about 1400 feet in the Koolau Mts., Oahu. Here also the Philippine wasp *Larra luzonensis* was seen on one of the trails, as well as a single worn specimen of the immigrant sphecid wasp *Isodontia harrisi* Fernald, first taken by Mr. Swezey and himself at Waianae.

OCTOBER 1, 1931

The 309th regular meeting of the Hawaiian Entomological Society was held at the Experiment Station, H.S.P.A., at 2:30 p.m., October 1, 1931.

Members present: Messrs. Ehrhorn, Hagan, Illingworth, Ito, Keck, Marlowe, Mason, McBride, Olsen, Rosa, Sakimura, Smith, Van Zwaluwenburg and Weinrich.

Visitors: Messrs. G. H. Godfrey and W. J. Hartung.

President Mason called the meeting to order and appointed Mr. Van Zwaluwenburg as secretary pro tem.

Mr. O. Wilford Olsen was elected to active membership.

Mr. Ehrhorn gave an interesting account of his visit to the Pacific Coast. He stated that the California Termite Commission is completing an exhaustive report which will be published by the end of the year. He described the treatment of timbers with creosote against termites, and gave an account of his visits to various scientific centers in California.

Dr. Hagan inquired about the distribution of the native Hawaiian rat, being particularly interested in the parasites of this rat.

Dr. Illingworth reported the native rat, *Rattus hawaiiensis* Stone* to be at present very numerous on Oahu from the Waianae Mts. to Kahala, though until lately it was believed to be confined to Popoia Island in Kailua bay. Specimens from Oahu were determined by Dr. Miller of the U. S. National Museum as the native rat, and Dr. H. E. Ewing reported that the parasites present were the same as those occurring on *R. concolor* of Asia. Dr. Illingworth expressed the opinion that *concolor* is the ancestor of *hawaiiensis* and of the other species of Pacific rats.

Mr. W. J. Hartung read a reference by Dr. A. D. Voûte (Landbouw, December, 1931, p. 715) describing the elimination of Lecanium and other scales from citrus trees in Java, by the simple expedient of eliminating ants from the trees by the use of tanglefoot on the trunks. Mr. Hartung exhibited gardenia plants infested with *Coccus viridis* (Greene), one of which, untreated, was heavily infested, while the other, banded with tanglefoot, had numerous larvae and pupae of *Azya luteipes* Muls. which had nearly eradicated the scale in a single month's time. It was suggested that the tanglefoot treatment was well adapted to coffee trees in Kona, where the green scale is a serious pest.

President Mason introduced Mr. O. Wilford Olsen, who spoke of his work at the University, and of his interest in the histophysiology of *Thrips tabaci* Lind. with reference to investigation of the reason why this species can pick up virus of pineapple yellow spot in the nymphal, but not in the adult stage.

Mr. Ehrhorn exhibited an excellent photograph taken in San Francisco on July 29 of Dr. L. O. Howard, Mr. Brosius, plant quarantine inspector at San Francisco, and himself.

NOVEMBER 5, 1931

The 310th regular meeting of the Hawaiian Entomological Society was held November 5, at 2:30 p.m., at the H.S.P.A. Experiment Station, Honolulu.

* See Occ. Papers, B. P. Bishop Museum, Vol. 3, no. 4, 1917.

Members present: Messrs. Au, Bianchi, Bryan, Ehrhorn, Fullaway, Hagan, Keck, Mason, Olsen, Pemberton, Rosa, Smith, Swezey, Van Zwaluwenburg, Wilder and Williams.

Visitors: Miss Amy Suehiro, Messrs. Krauss and Phillips.

President Mason called the meeting to order.

The minutes of the preceding meeting were read and approved.

President Mason enquired re the work of the committee on procuring photographs of entomologists. Mr. Ehrhorn presented the society with photographs, chiefly of Dr. L. O. Howard.

Mr. Fullaway made a motion of appreciation of Mr. Ehrhorn's donation of the pictures. Seconded by Mr. Wilder and passed.

On President Mason's suggestion, it was decided to have a picture taken of the Entomological Society, at the annual (December) meeting.

PAPERS

"Micropezidae From the Indo-Pacific Region."

BY E. H. BRYAN, JR.

"Insect Exploration in the Hilo Forest Reserve at the 5000 ft. Level."

BY O. H. SWEZEY AND F. X. WILLIAMS.

"Insects From the Summit of Mauna Kea."

BY O. H. SWEZEY AND F. X. WILLIAMS.

Mr. Van Zwaluwenburg presented the title of a paper by Dr. J. W. Folsom, on **"Hawaiian Collembola."**

NOTES AND EXHIBITS

Sciomyza hawaiiensis Grimshaw.—Mr. Bryan exhibited specimens of this fly. He stated that it had remained unknown in collections until Dr. Aldrich recently determined specimens, which had been among some undetermined species. It is now known from many parts of Oahu, as well as from Puna, Hawaii; Kapaa, Kauai; and Kailua and Keanae, Maui. It is locally abundant, and probably of general distribution on the larger islands of the group.*

* *Chiromyia* (*Scyphella*) *flava* (Linn.). See Proc. Haw. Ent. Soc. VI, p. 228, 1926.

Coccotrypes dactyliperda (Fab.).—Mr. Swezey reported having collected this scolytid under date palm trees in the grounds of Lihue Hotel on Kauai, March 11, 1928, which is the first record of its occurrence on that island.

Coccotrypes pygmaeus (Eich.).—Mr. Swezey also reported collecting this beetle at the same place on Kauai as *C. dactyliperda,* which would be its first record for Kauai.

Diorymerellus laevimargo Champ.—Mr. Swezey called to attention that this orchid weevil has escaped being recorded in the Proceedings of the Hawaiian Entomological Society, except for the time when it was first exhibited as an unknown weevil, captured by Dr. Lyon on an orchid. See Proc. Haw. Ent. Soc. III, p. 83, 1915. The beetle was first found on an orchid (Dendrobium) by Dr. H. L. Lyon, July 20, 1914; again October 5, 1914; and again February 2, 1915.

Sitophilus rugicollis (Casey).—Mr. Swezey exhibited two specimens of this calandrid beetle, one taken September 19, 1931, at the Vineyard Street Nursery, and the other at the grounds of the Experiment Station, H.S.P.A., October 12, 1931. The only previous record of this weevil in Hawaii is a specimen caught in house in 1928, recorded in Proc. Haw. Ent. Soc. VII, No. 2, p. 279, 1929. The finding of the latest specimens indicates that it must be established here. It remains to be learned what seed it lives in. In India it is known to attack the seeds of *Shorea robusta* and *Dipterocarpus turbinatus.*

Volucella pusilla Macq.—Mr. Swezey reported that Mr. W. J. MacNeil had handed him four specimens of this syrphid fly that had been reared from maggots found in rotten cactus stem. It is the first record of its breeding habits. The first specimen of this recent immigrant was taken in Oahu Sugar Co. plantation, October 30, 1930. It was later found quite common at Red Hill and in Manoa Valley.

Epilachna boisduvali Muls.—Miss Suehiro presented a note and exhibit of an Epilachna from Samoa. Among the insects collected in Samoa by D. T. Fullaway, and presented to the Bishop Museum, is a Coccinellid which closely resembles *Epilachna*

boisduvali Muls. This is a new record for Samoa. *E. boisduvali* has been previously recorded from Fiji and New Caledonia.

Culex nigriceps Edwards in Tahiti.—Mr. Bryan exhibited specimens of this mosquito from Tahiti, which had been sent to him by Dr. P. H. Buxton, of the London School of Hygiene and Tropical Medicine. In the Bulletin de la Société des Études Océaniennes, No. 21, for October, 1927, Dr. Buxton states that this species is found only in Tahiti. He speaks of it as a dark species, with white spots over the eyes, but without any other markings on the body or legs.

Other mosquitoes recorded from the Society Islands are:

Culex fatigans Wied.
Culex annulirostris (Skuse).
Aedes aegypti (Linn.).
Aedes variegatus Doleschall.

Dr. Williams spoke of, and exhibited some insects taken at Nauhi, Hawaii, 5200 ft. and over, during September and October of this year. They included the vegetable weevil, a species of Scatella breeding in a water pocket in a tree at 5800 ft. Also a *Brachydeutera* breeding in a gallon of water in an iron pot at Keanakolu, 5250 ft. He exhibited larvae of a staphylinid beetle parasitized by a proctotrypid wasp.

At this altitude, no termites nor ants could be found, though Culex mosquitoes were present. No Scolopendra centipedes, no Heteropoda spiders. Bats were fairly common and were on the wing shortly after 4:00 p.m. Native hawks were present in the mamani (Sophora) zone.

Mr. Fullaway gave an account of his trip to the Orient in quest of thrips parasites and of the difficulty of rearing these tiny parasitic wasps. He said that in the Orient he observed that the taro leafhopper (*Megamelus proserpina* Kirk.) was well controlled by parasites.

Mr. Mason spoke of an outbreak of armyworms near Woodlawn, Honolulu. Two or three acres of grass had been eaten. The caterpillars were on the march. It was remarked by Fullaway that armyworms were also common in the Hind-Clarke dairy region, and by Pemberton, at Waimanalo.

Copris incertus var. *prociduus* (Say).—Mr. Ehrhorn said that Dr. Wilder and himself had found the Mexican dung beetle common at Kula, Maui.

DECEMBER 3, 1931

The 311th regular meeting of the Hawaiian Entomological Society was held at the Experiment Station of the Hawaiian Sugar Planters' Association on December 3, 1931, at 2:30 p.m.

Members present: Messrs. Bianchi, Bryan, Carter, Ehrhorn, Fullaway, Hagan, Hong, Illingworth, Ito, Keck, Lau, Marlowe, Mason, McBryde, Olsen, Pemberton, Rosa, Sakimura, Smith, Swezey, Van Zwaluwenburg, Wilder and Williams.

Visitor: N. H. Krauss.

President Mason called the meeting to order.

The minutes of the previous meeting were read and approved.

The Secretary read the minutes of a meeting of the executive committee and the correspondence thereof, held at the instance of the Chairman of the Pacific Entomological Survey for the purpose of expressing its views relative to the continuation of the work of the Pacific Entomological Survey.

It was moved by Dr. Carter, seconded by Dr. Wilder and passed by the Society, that this act of the Executive Committee be approved.

In this connection Messrs. Swezey and Bryan exhibited two preliminary reports of the Pacific Entomological Survey. These reports were excellent.

The secretary-treasurer reported on the finances of the Society for 1931.

The receipts were $653.95, the expenditures $520.63 and the cash on hand December 3, 1931, $133.32.

Officers elected for 1932:

President—Dr. R. N. Chapman.
Vice-President—Dr. Harold Hagan.
Secretary-Treasurer—Dr. F. X. Williams.
Executive Committee—O. C. McBryde and E. M. Ehrhorn.

After a short business speech by President Mason, the members of the Society went out of doors, in a suitable place, and had a photo taken.

PAPERS

The President delivered his annual address.

"The Economic Importance of the Mediterranean Fruit Fly to Hawaiian Horticulture."

"Some Effects of Pseudococcus Brevipes (Ckl.) **on Pineapple Fruits."**

BY DR. WALTER CARTER AND K. ITO.

"Notes on Insects Found on Pineapple Planting Material."

BY K. ITO AND DR. WALTER CARTER.

"A Leafhopper Burn of Cucurbits on Oahu, T. H."*

BY DR. WALTER CARTER.

Mr. O. H. Swezey presented a paper by title:

"Descriptions of New Encyrtidae and Scelionidae from the Philippines and Malay States."

BY P. H. TIMBERLAKE.

"New Species of Hawaiian Lepidoptera."

BY O. H. SWEZEY.

NOTES AND EXHIBITION OF MATERIAL

Celphalonomia tarsalis (Ashm.).—Mr. Swezey reported that he had recently received from Mr. Gahan this determination of a bethylid that has on several occasions been reared from cocoons found in raisins infested with *Oryzaephilus surinamensis* (L.). This bethylid is nearly a cosmopolitan species, and it is the first time it is recorded in Honolulu. Mr. Swezey's dates of collection in Honolulu are: January 4 and 10, 1916; October 24, 1925; September 3, 1926; and February 15, 1930. It is the *Cephalonomia* sp. mentioned in Proc. Haw. Ent. Soc., III, p. 260, 1917.

Acerophagus notativentris (Gir.).—Mr. Swezey reported that Mr. Timberlake had identified as this encyrtid, a specimen which had issued October 30 from the parasitized mealybugs in a bunch of grapes from California. Three more parasites had issued, but

*Not available for publication [Ed.]

were lost. The mealybug was not identified, but might have been *Pseudococcus maritimus* (Ehrhorn).

Cardiocondyla wroughtonii var. *hawaiiensis* Forel.—Mr. Swezey called to attention that in a paper in Psyche, Vol. 38, p. 83, 1931, Dr. Wheeler mentions a gynandromorph ant of this species, which is in the collection at the Experiment Station, H.S.P.A. It is the same specimen recorded in Proc. Haw. Ent. Soc., VI, p. 229, 1926, as "apparently *Cardiocondyla nuda minutior* Forel." Dr. Wheeler also mentions that in the same collection he found another gynandromorph ant of the same species.

Philippine Anagyrus.—Dr. F. X. Williams reported the recovery of the Philippine Anagyrus wasp, parasitic in our pink sugar cane mealybug, at Koloa Sugar Company on November 20, 1931, and Grove Farm Company, Ltd., and Lihue Plantation, Ltd., on November 13, 1931, all on the island of Kauai. This parasite was received from F. C. Hadden at Los Banos, Luzon.

Aeschrithmysus n. sp. (?).—Dr. Williams exhibited a longicorn beetle (Aeschrithmysus ?), probably a new species. A single female was reared from the stem of *Vaccinium peleanum* Skotts., procured October 3, 1931, above Nauhi, Hawaii, at an elevation of about 8500 feet, issued on November 27, 1931.

Athesapeuta cyperi Marshall.—Mr. Pemberton spoke of having found the nutgrass weevil established at Waianae, Oahu.

*Mutillid on Oahu**.—Professor Olsen mentioned that a female mutillid wasp had recently been taken on Oahu by one of his students.

Volucella pusilla Macq.—Mr. Fullaway reported that he collected this syrphid fly at Waianae, Oahu.

* It was later ascertained that the specimen had probably been obtained from the mainland. [Ed.]

Micropezidae (Diptera) From the Indo-Pacific Region

BY E. H. BRYAN, JR.

(Presented at the meeting of November 5, 1931)

The following species of Micropezidae in the collections of B. P. Bishop Museum have been determined by E. T. Cresson, Jr., of the Academy of Natural Sciences, Philadelphia.

Tanipoda caligata Rondani.

Manorg, W. Borneo, (Muir).

Tanipoda cubitalis Rondani.

Noesa, Kambangan, Java, December, 1908, (Terry).

Calobata albitarsis Wiedemann.

Pontianak, Borneo, (Muir); Pekalongan, Java, April, 1907, (Muir).

Calobata galbula Osten Sacken.

Los Banos, P. I., August, 1916, (Williams); Singapore, March, 1907, (Muir); Guam, (Fullaway).

Taniaptera albimana Dol.

Amboina, July, 1908, (Muir).

Telostylus latibrachium End.

Buitenzorg, Java, (Muir).

Nerius (Telostylinus) lineolatus Wiedemann.

Rewa, Fiji, 1929, (Pemberton); Nausori, Fiji, 1913, (Illingworth); Guadalcanar, Solomon Is., 1921, (Kusche); Pontianak, Borneo, (Muir); Amboina, 1908-9, (Muir); Makassar, Celebes, January 8, 1909, (Terry), April, 1908, (Muir); Cairns, N. Queensland, 1918, (Illingworth).

Nerius (Rhoptrum) annulipes Dol.

Amboina, 1907-8, (Muir).

Nerius (Rhoptrum) mantoides Walker.

Laloki, Papua, 1910, (Muir).

Nerius (Gymnonerius) fuscus Wiedemann.

Java, 1907, (Muir).

Gymnonerius dimidiatus Cresson.

Los Banos, P. I., 1916, (Williams). (Type and Allotype).

Eurybata hexapla Osten Sacken.

Los Banos, P. I., 1917, (Williams).

Eurybata semilauta Osten Sacken.

Amboina, (Muir).

Eurybata nigriventris End.

Manorg, W. Borneo, (Muir).

Nestima polita Osten Sacken.

Laloki, Papua, 1910, (Muir).

Mimomyrmecia tessellata Frey.

Los Banos, P. I., 1916, (Williams); Manila, P. I., January, 1908, (Thompson).

A New Species of Proisotoma (Order Collembola) from India

BY JAMES MEIKLE BROWN, B.SC., F.L.S., F.E.S., SHEFFIELD, ENGLAND

(Presented by Dr. F. X. Williams at the Meeting of April 2, 1931)

Three specimens of a species of Collembola were forwarded by Dr. F. X. Williams of the Experimental Station of the Hawaiian Sugar Planters' Association for determination, and as they do not appear to conform in structure to any recognized species, a description is appended. The specimens were intercepted in quarantine at Molokai, Hawaiian Islands, from "seed pieces" of sugar cane packed in moist charcoal in metal containers that were received from Coimbatore, India, in early December, 1930.

I have to thank Dr. Imms of Rothamsted for the opportunity of examining and describing the specimens.

Proisotoma (Isotomina) indica sp. n.

Colour greyish-white, with very little bluish-black pigment in the form of small round spots at the front and sides of the head, and as faint patches dorsally on the posterior segments. Eye patch only partially pigmented, densely so in front, more sparsely so elsewhere. Fig. 1.

Hairs short and uniformly scattered, very slightly curved and almost adpressed. The posterior segments with a few slightly longer ones. All the hairs simple.

Antennae slightly longer than the head, as 11 : 9. Antennal segments approximately as 11 : 6 : 7 : 5. Segment I without specialized olfactory hairs. Antennal organ II typical.

Eyes five on each side, the anterior ones obscured by the pigment of the eye-patch.

Mandibles with four apical teeth, and strong masticatory ridges.

Postantennal organ oval, slightly contracted at about the middle, with thickened margins, and a projecting curved ridge reaching from the middle of the posterior margin across the centre of the organ to near the anterior border, and tapering to a point. Figs. 1 and 2.

Legs without tenent hairs. Claw with one very small tooth slightly beyond the middle. Empodial appendage narrow and pointed, reaching to the tooth of the claw, the outer lamella narrow, the inner lamella wider but without a strongly rounded inner angle. Fig. 3.

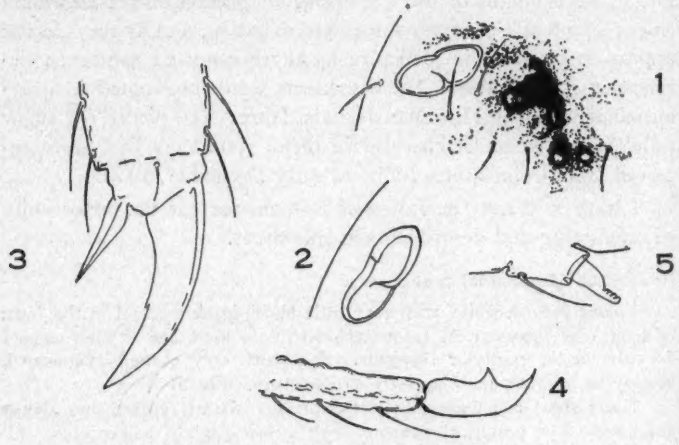
Fork not reaching to the ventral tube. Dentes about twice the length of the manubrium. Manubrium with two strong ventral bristles on each side of the apex, dorsally with a few scattered hairs. Dentes ringed dor-

sally except at the extreme base and apex, with several dorso-lateral hairs. Ventrally with the usual arrangement of adpressed hairs, about nine in number, the last not reaching beyond the middle of the mucro. Mucrones with two almost equal teeth. Fig. 4.

Tenaculum with four barbs on the rami and a strong curved bristle on the corpus. Fig. 5.

Abdominal segment IV slightly longer than segment III, as 6 : 5. Segments V and VI combined and together about equal to segment III.

Size from .8 to .9 mm.



Proiostoma (Isotomina) indica

FIG. 1. Side of head, showing postantennal organ and pigmentation of eye-patch.
FIG. 2. Post-antennal organ.
FIG. 3. Apex of leg.
FIG. 4. Apex of spring, showing mucro.
FIG. 5. Tenaculum.

Locality: Three specimens, on cane cuttings, Coimbatore, India.

The type slide will be deposited in the British Museum (South Kensington).

This species bears a strong likeness to *Proisotoma (Isotomina) thermophila* (Axels.), a species which is found occasionally in hothouses in Europe; but differs from it essentially in the number of eyes, the structure of the post-antennal organ, the number of bristles at the apex of the manubrium, and in other minor details.

Some Effects of *Pseudococcus brevipes* (Ckl.) on Pineapple Fruit *

BY DR. WALTER CARTER AND K. ITO

(Presented at the meeting of December 3, 1931)

During the harvest season of 1931 considerable spoilage of pineapple fruit was reported, caused by cracking of the basal eyes with a resultant leaking of juice from the fruit. The leaking fruits were invariably infested with souring beetles and at the bases of the fruit evidence was clear that high mealybug populations either were, or had been present. In our experimental plot, which had been used for spray experiments for some time previously, it was possible to compare fruits that had been kept clean of mealybugs with those on which high populations had developed. On examination of these plots it was clearly suggested that mealybug infestation bore a close relationship to cracked and leaky fruits. In order to obtain more exact data on this subject a section of the field, California Packing Corporation Field 71, Kunia, Oahu, where a critical study of mealybug population growth and progress into the fields has been made, was selected as a source for obtaining fruit both uninfested and heavily infested with mealybugs.

The section consisted of two sprayed blocks, A and C, on either side of a check or unsprayed block, B. Only the outer eight beds on one end of the sprayed blocks were sprayed with an oil emulsion to keep out the gradual influx of mealybugs from the adjacent wild vegetation. Successive samples of plants taken within these blocks showed that the central portions of the two sprayed blocks were relatively free of mealybugs, or at least with a very light infestation. On the other hand, the outer beds of the check block were very heavily infested with mealybugs.

Here, as elsewhere, it was observed that mealybugs have a tendency to congregate on the more tender portions of the pineapple plant. Prior to the development of the inflorescence, the

* Published with the approval of the Director as Technical Paper No. 45 of the Experiment Station of the Association of Hawaiian Pineapple Canners, University of Hawaii.

mealybugs infest the central tender leaves, but when the fruit is formed, they move up to the fruit and thence to the crown. They propagate to an enormous population on the crown and maturing fruit, especially on the butt end of the fruit where they are more or less sheltered and protected from the numerous predators.

Analysis of the last sample taken on July 2-7, 1931, indicated that beds 36 to 45 of Block A and beds 26 to 40 of Block C had only a very light infestation of mealybugs, whereas beds 1 to 15 of Block B had a very heavy infestation. To facilitate sampling, each of the three blocks was subdivided into small plots of five 60-foot beds, thus forming five plots throughout the width of the 300-foot block. Crown samples were taken at every tenth plant interval, alternately from the first, second and third lines of every odd 3-line bed of each plot of the three blocks. Thus, 12 crown samples were taken from each 300-foot bed.

Out of the 120 samples, taken from the above designated 10 beds of Block A, only one crown had a single mealybug, and of the 180 samples from that of the 15 beds of Block C, 28 were infested with an average of 47 mealybugs per crown infested. Contrastingly, out of the 180 samples taken from the first 15 beds of check Block B, all crowns had a heavy infestation with an average of 190 mealybugs per crown infested. (See Table 1).

The assumption was made that the degree of mealybug infestation on the crowns was indicative of the infestation on the fruits. Subsequently, all ripe fruits were picked from within the designated portions of each of the three blocks on July 23, 1931, when the fruits became mature. They were packed into regular pineapple crates which were marked and segregated according to the respective blocks. These crates of fruits were then brought into the laboratory for inspection.

In the laboratory, each fruit was examined for any superficial manifestations of cracked and leaky spots among the "eyes" of the fruits. The fruits were thereby classified as normal, those showing no cracked or leaky spots; cracked, those with corked-over cracks only; and leaky, those from which the juice was exuding from cracks in the corky tissues. The following record shows the results of the examination:

TABLE 1

Mealybug population from crowns with associated data on fruit quality:

Block No.	No. of Crowns in Sample	Percentage of Crowns Infested	Average Population of Mealybugs per Infested Crown	Normal Fruits	Cracked Fruits	Leaky Fruits	Total No. of Fruits Examined
A	120	0.8	1	232	18	0	250
B	180	100	190	92	176	36	304
C	180	15.5	47	299	29	4	332

Although no quantitative data were obtainable on the subject, it was also indicated that the establishment of heavy mealybug populations on the base of fruit so weakened the tissue between the "eyes" that entrance of the souring beetles was very much facilitated. It is also true that a leaky fruit rapidly becomes a fermenting fruit, so that the indirect effect of mealybugs in encouraging souring beetle infestation must also be reckoned with.

CONCLUSION

The results clearly indicate that the presence of mealybugs in large populations at the base of fruits considerably reduces the quality of fruit by rendering the basal slices unmarketable as well as increasing the number of culls due to leaking and fermentation. No laboratory experiments have been undertaken, but the clear correlation in the field data seems to be conclusive on these points.

Notes on Insects Found on Pineapple Planting Material*

BY K. ITO AND DR. WALTER CARTER

(Presented at the meeting of December 3, 1931)

In the study of insects and their relation to pineapple production, investigations have shown that injurious insects, such as mealybugs and scales, which are closely attached to the host plant upon which they feed and propagate, can be disseminated over a wide area by the use of planting materials infested with them.

At the present time it would appear that the difficulties of mechanical handling precludes the treatment of planting material prior to planting in the usual fall planting season. Experience has shown, as a matter of fact, that the great majority of the insect populations on this planting material disappear due to natural causes within a few months after planting, even though the percentage that remains infested still presents an important problem. The planting material to be used for replanting, however, is stored on trimming grounds during winter in closely packed masses. Frequently this material can be seen heavily infested with *Diaspis bromeliae* (Kern.), the pineapple scale, when it is planted in the spring. It was thought that possibly some simple method of treating this planting material could be devised which would insure cleaner planting material being used for replants. The importance of using clean planting material for replants is very great since at the time it is planted the surrounding plants are growing in a very succulent condition, so that there is a tendency for the insects on the dry freshly planted replants to move on to the adjoining older plants. The result is that considerable spread of insects may occur.

In December, 1930, an experiment to determine the effect of high temperature in checking insect infestation on pineapple planting material, while in the process of curing on the trimming grounds, was initiated at two separate localities in the Helemano section of the Hawaiian Pineapple Company's fields. The

* Published with the approval of the Director as Technical Paper No. 48 of the Experiment Station of the Association of Hawaiian Pineapple Canners, University of Hawaii.

primary purpose of this investigation was to collect quantitative data on insect fauna present and to determine the effect of atmospheric heat on the pineapple scale infesting planting material.

In carrying out the experiment, part of the planting material on the trimming ground was enclosed, butt ends up, under a large celoglass-covered enclosure where the temperature was thought to become sufficiently increased to clean the planting material of insect infestation. Another part of the material was left out in the open, with the butts of the plants turned upward, as in ordinary practices of curing.

Temperature records were kept of three different conditions at the two places as follows: (1) Thermograph under standard shade; (2) with the thermo-element placed at a horizontal position about two inches above the ground in the middle of the check materials; (3) with the thermo-element placed at a horizontal position about two inches above the ground in the middle of the material under the celoglass-covered enclosure.

Final analysis of the different thermograph records at the two places showed no marked significance so far as the anticipated effects of temperature were concerned. The various insects seemed to persist under both celoglass and check conditions. Although the temperature rose as high as 99°F. when a mercury thermometer was exposed to the air on the butts of the plants under the celoglass, the temperatures obtaining within the mass of material showed only slightly higher temperature fluctuations than under the check, due to the insulation that the closely appressed planting material provided to the penetration of heat to the lower portions of the plant on which the insects were invariably found.

Comparison of the corresponding records of the two places manifested no greater variations than those encountered in the different sets of the one place. Consequently, all the following data on insect populations have been combined and considered as having existed under the same conditions of environment. Table 1 shows the weekly average maximum and minimum temperatures for the duration of the experiment.

TABLE 1. HELEMANO STATION STANDARD SHADE HYGROTHERMOGRAPH RECORD

Week ending	Temperature		Humidity	
	Av. of daily maxima	Av. of daily minima	Av. of daily maxima	Av. of daily minima
12/21/30	74.5	67.1	89.0	57.0
12/28/30	75.1	62.7	90.0	53.0
1/ 4/31	74.9	62.4	84.5	50.1
1/11/31	75.8	65.6	89.0	55.3
1/18/31	75.0	61.3	89.9	52.1
*1/25/31	75.5	55.2	91.2	45.7
2/ 1/31	74.1	59.8	90.9	51.9
2/ 8/31	73.6	61.9	89.6	50.1
2/15/31	71.3	63.3	91.5	61.4
2/22/31	75.3	64.6	90.7	50.7
3/ 1/31	73.5	62.0	91.7	57.3
3/ 8/31	73.9	60.6	89.4	49.6
3/15/31	76.2	59.9	91.1	50.8

Records of the different species of insects encountered during the dissection of the planting material samples for the counting of the scales on the leaves are shown in Table 2. The first random sample of 55 plants was examined on December 17-19, 1930, at the beginning of the experiment and illustrates the kinds and degrees of initial populations. The data from the second sample were obtained by examining 120 plants at the conclusion of the experiment on March 25, 1931, and represent the populations that had accumulated during the winter. To simplify comparison, the data presented in the tables are a revision of the original data from the two unequal samples calculated on the basis of 100 plants per sample.

* Average of three days only. Recorder had stopped.

TABLE 2. INSECT SPECIES FOUND ON PINEAPPLE PLANTING MATERIAL STORED ON TRIMMING GROUNDS

Insect Species	No. of Individuals 1st Sample Dec. 1930	2nd Sample Mar. 1931
Araneida (Spiders)*	36	7
Acarina (Mites)	36	3
Collembola (Springtails)	38	67
Orthoptera:		
Blattidae (*Cutilia soror* Brunner)	....	1
Dermaptera (*Euborellia annulipes* Lucas)*	....	3
Corrodentia (*Ectopsocus fullawayi* Endl. and *E. hawaiiensis* Endl.)	104	27
Thysanoptera:		
Phloeothripidae (*Dolerothrips carteri* Watson)	129	51
Homoptera:		
Coccidae (*Pseudococcus brevipes* Ckll.)	293	11
(*Diaspis bromeliae* Kerner)	5851	583
Hemiptera:		
Reduviidae (*Empicoria rubromaculata* Blkb.)*	....	7
Coleoptera:		
Coccinellidae (*Sticholotis punctatus* Crotch)*	....	2
Nitidulidae (*Carpophilus humeralis* Fabr.)	....	1
Cucujidae (*Cryptamorpha desjardinsi* Guer.)*	....	20
Diptera:		
Chironomidae (Midge larvae)	63	8
Lepidoptera:		
Tineidae (*Ereunetis flavistriata* Walsm.)	80	5
Hymenoptera:		
Formicidae (*Pheidole megacephala* Fabr.)	13	1

CONCLUSION

It appears clear from the data that pineapple scale can maintain itself on dried planting material on the trimming ground. The same is true of the pineapple mealybug, *Pseudococcus brevipes* (Ckl.), in a lesser degree. At the beginning of the experiment the initial populations consisted mainly of phytophagus insects. The sample at the close of the experiment showed the persistence of these species with considerable reduction in numbers and the introduction of a number of predacious forms. It would appear then that careful selection of planting material to be used as replants would constitute the best control, since the reproduction of any phytophagus forms which may be on the plant would be severely limited by the accumulation of predators.

* Predacious forms.

Descriptions de trois Melasides nouveaux provenant des collections de la "Experiment Station of the Hawaiian Sugar Planters' Association"

PAR E. FLEUTIAUX

(Presented by R. H. Van Zwaluwenburg at the meeting of Sept. 3, 1931)

Fornax striatus nov. sp.

Long. 5m/m ½—Allongé, atténué, convexe; ferrugineux, élytres noirs; pubescence jaune sur la tête et le pronotum, obscure sur les élytres. Tête convexe, densément ponctuée; épistome déprimé, aussi large à la base que la crête surantennaire; carène interoculaire interrompue au milieu. Antennes longues, dépassant la moitié du corps, épaisses, filiformes jusqu'à la moitié, comprimées et élargies à partir du 7e article; noires, premier article ferrugineux; 2e article très court, beaucoup moins long que le 4e; 3e plus long que le suivant. Pronotum aussi long que large, légèrement rétréci en avant, très convexe très densément et rugueusement ponctué. Elytres convexes, atténués, obliquement tronqués au sommet, terminés par une courte épine; rugueux, moins fortement vers le bout, fortement striés, moins profondément en arrière. Dessous ferrugineux, métasternum et hanches postérieures noirâtres; fortement ponctué. Episternes métathoraciques nuls en avant, élargis en arrière. Hanches postérieures peu dilatées en dedans, plus larges en dehors que le bord inférieur des épisternes; abdomen comprimé sur les bords; dernier arceau ventral atténué. Pattes testacées; griffes dentées.

Nouvelle-Guinée: Koitaki, 1500 ft., novembre—décembre 1928 (Pemberton).

Espèce remarquable par sa forme convexe; sa surface rugueuse; ses antennes longues et élargies à partir du 7e article; ses épisternes élargis en arrière, nuls en avant; ses hanches postérieures plus larges en dehors que les épisternes. Se place dans le voisinage de *F. umbilicatus* Fleutiaux, de Bornéo.

Fornax (Ceratus) haddeni nov. sp.

Long. 8 m/m—Oblong, elliptique, épais; brun foncé; pubescence jaune. Tête convexe, densément ponctuée; épistome aussi large à la base que la crête surantennaire; carène interoculaire interrompue au milieu. Antennes filiformes, ne dépassant pas la base du prothorax, ferrugineuses; 3e article un peu plus long que le 2e et de même forme, notablement moins long que le 4e. Pronotum à peu près aussi long que large à la base, arrondi et graduellement rétréci en avant, convexe, densément ponctué. Elytres graduellement rétrécis en arrière, finement pointillés, substriés. Dessous de même couleur, finement pointillé. Hanches postérieures très larges en

dedans, anguleuses en arrière. Dernier arceau ventral légèrement échancré ou tronqué au sommet. Pattes ferrugineuses.

Iles Philippines: Mont Makiling, Laguna, 400 ft., avril 1931 (F. C. Hadden).

Ressemble beaucoup à *C. crassus* Fleutiaux, mais plus allongé.

Arhipis striata nov. sp.

Long. 8 m/m—Oblong, parallèle, brun rougeâtre; pubescence réduite à quelques poils jaunes sur les flancs des élytres. Tête aplatie en avant; ponctuation ombiliquée, rugueuse; épistome court, très rétréci à la base où il est plus large que la crête surantennaire; bord antérieur sinué, prolongé latéralement. Antennes ferrugineuses, courtes; 3e article à peu près aussi long que les trois suivants réunis. Pronotum à peine plus long que large, parallèle, arrondi aux angles antérieurs, déprimé sur le dos, légèrement sillonné en avant au milieu, et marqué d'une ligne lisse médiane en arrière; ponctuation ombiliquée serrée. Elytres rugueux et striés. Dessous un peu plus clair. Pattes ferrugineuses.

Iles Philippines: Mont Makiling, Laguna, avril 1931 (F. C. Hadden).

Cette espèce est facile à distinguer de *A. orientalis* Fleutiaux par sa forme plus courte, par ses élytres rugueux et plus fortement striés, et par la carène du bord antérieur du pronotum dirigée un peu au-dessus de la carène postérieure, comme dans le genre Farsus; mais cependant moins brusquement recourbée en arrière.

Descriptions d'Elaterides nouveaux des Iles Philippines, provenant des collections de la "Experiment Station of the Hawaiian Sugar Planters' Association"

PAR E. FLEUTIAUX.

(Presented by R. H. Van Zwaluwenburg at the meeting of Sept. 3, 1931)

Anchastus philippinensis nov. sp.

Long. 8 m/m ½—Allongé, elliptique, convexe; testacé brillant; pubescence jaune. Tête régulièrement convexe, ponctuée; bord antérieur arrondi. Antennes testacées, ne dépassant pas la base du prothorax; 3e article plus long que le 4e. Pronotum aussi long que large, arrondi latéralement et rétréci en avant, convexe; ponctuation peu serrée; angles postérieurs fortement et obliquement carénés. Elytres arrondis et atténués, finement pointillés, légèrement striés-ponctués; interstries plans. Dessous et pattes plus pâles.

Iles Philippines: Mont Makiling, Laguna, avril 1931 (F. C. Hadden).

Plus grand et plus étroit que *A. nitidus* Candèze; ponctuation du pronotum plus forte et plus dense; stries des élytres moins marquées; 3e article des antennes plus long que le 4e.

Megapenthes frontalis nov. sp.

Long. 6 m/m.—Allongé, peu convexe; pubescence jaune très légère. Tête noire, jaunâtre en avant, déprimée, carénée au milieu; bord antérieur arrondi et rebordé; ponctuation ombiliquée et rugueuse. Antennes dépassant la base du prothorax, serriformes, avec les 2e et 3e articles courts, globuleux; noires, les trois premiers articles jaunes. Pronotum noir, jaune à la base, plus long que large, graduellement rétréci en avant, peu convexe, ponctuation ombiliquée, serrée; angles postérieures grands, aigus, dirigés en arrière, bicarénés, la carène externe longue. Ecusson noir, triangulaire, fortement ponctué. Elytres noirs, jaunes à la base, entiers au sommet, rugueux, fortement striés-ponctués. Dessous jaune. Pattes plus claires.

Iles Philippines: Mont Makiling, Laguna, avril 1931 (F. C. Hadden).

Voisin de *M. inconditus* Candèze, mais de taille beaucoup plus petite; ponctuation plus forte, plus serrée et rugueuse. Se rapproche également de *M. curtus* Candèze; plus étroit, aspect moins brillant; plus noir, avec des taches jaune pâle; pronotum moins arrondi latéralement et graduellement rétréci; ponctuation plus

serrée; élytres plus rugueux et plus fortement ponctués-striés.

Megapenthes philippinensis nov. sp.

Long. 9 à 11 m/m ½—Oblong, atténué en arrière, convexe; brun clair brillant, parfois plus ou moins noirâtre sur le pronotum; pubescence jaune. Tête convexe, densément ponctuée; bord antérieur arrondi et rebordé. Antennes brun clair, fines, courtes; 3e article insensiblement plus court que le 4e. Pronotum à peu près aussi long que large, sinué sur les côtés, rétréci seulement aux angles antérieurs, convexe; ponctuation fine et peu serrée; angles postérieurs divergents, aigus, bicarénés. Elytres de la largeur du pronotum, graduellement atténués, finement pointillés, légèrement ponctués-striés. Dessous de même couleur, parfois noirâtre. Hanches postérieures peu élargies en dedans, anguleuses en arrière. Pattes jaunes.

Iles Philippines: Mont Makiling, Laguna, avril 1931 (F. C. Hadden).

Voisin de *M. inconditus* Candèze, forme plus atténuée; couleur plus claire; front non caréné; ponctuation beaucoup plus légère; antennes moins longues et plus fines; hanches postérieures moins élargies en dedans.

Megapenthes angustus nov. sp.

Long. 7 à 9 m/m—Allongé, filiforme; brun noirâtre, base des élytres parfois jaune; pubescence jaune. Tête convexe et densément pounctuée, arrondie en avant. Antennes fines, ne dépassant pas la base du prothorax; noires, premiers articles ferrugineux; 3e plus long que le 2e et moins que le 4e. Pronotum beaucoup plus long que large, parallèle, ponctué comme la tête; angles postérieurs aigus, bicarénés. Elytres de la même largeur que le pronotum, graduellement atténués, tronqués au sommet, ponctués-striés. Dessous noir. Pattes jaunes.

Iles Philippines: Mont Makiling, Laguna, avril-mai 1931 (F. C. Hadden). Whitehead l'a également pris autrefois à Luzon.

Voisin de *M. maceratus* Candèze, plus petit, plus noirâtre; pronotum plus parallèle; stries des élytres mieux marquées.

Neodiploconus haddeni nov. sp.

Long. 9 à 12 m/m—Allongé, peu convexe; noir brillant, pronotum sanguin, parfois noirâtre sur le bord antérieur et au sommet des angles postérieurs; pubescence jaunâtre. Tête convexe, arrondie et rebordée en avant; ponctuation forte et peu serrée. Antennes ferrugineux; 2e et 3e articles petits. Pronotum plus long que large, légèrement et graduellement rétréci en avant, peu convexe, sillonné au milieu en arrière; ponctuation très fine et écartée, un peu plus forte en avant; angles postérieurs aigus et bicarénés. Ecusson rouge ou noirâtre. Elytres graduellement atténués

(tronqués au sommet chez la ♀), presque lisses, très légèrement ponctués-striés, nullement vers le bout. Dessous et pattes sanguins.

Iles Philippines: Mont Makiling, Laguna, 400 ft, avril 1931 (F. C. Hadden); Baguio, juin 1917 (F. X. Williams); Baguio-Benguet (Baker).

Plus étroit que *N. melanopterus* Candèze, 1864, de Sumatra; front moins fortement ponctué, à peine prolongé en avant; ponctuation du pronotum beaucoup plus fine; élytres indistinctement striés; dessous sanguin.

Neodiploconus marginatus nov. sp.

Long. 11 à 13 m/m—Allongé, peu convexe; rouge ferrugineux brillant, élytres bordés de noirâtre; pubescence jaune. Tête convexe, arrondie et rebordée en avant, fortement et densément ponctuée. Antennes minces, ferrugineuses; 3e article à peine plus long que le 2e, beaucoup plus court que le 4e. Pronotum plus long que large, légèrement et graduellement rétréci en avant; ponctuation un peu moins grosse et moins serrée que sur la tête; angles postérieurs aigus, divergents, bicarénés. Elytres graduellement atténués en arrière, finement pointillés et légèrement ponctués-striés. Dessous ferrugineux. Pattes plus claires.

Baguio, juin 1917 (F. X. Williams); Baguio-Benguet (Baker).

Voisin de *N. ciprinus* Candèze; plus étroit, plus brillant, plus légèrement ponctué; élytres très légèrement striés, bordés de noir.

Hawaiian Collembola

BY J. W. FOLSOM, U. S. BUREAU OF ENTOMOLOGY.

(Presented by R. H. Van Zwaluwenburg at the meeting of Nov. 5, 1931)

The main purpose of this paper is to provide the entomologists of Hawaii with names for the Collembola of their pineapple and sugar cane soils. Some of these insects are known to damage the roots of those plants.

This article deals with twenty-seven species, of which eighteen are new. One new variety and two new genera, Stachia and Denisia, are described.

Hitherto the only Collembola known from Hawaii have been the five species described by Dr. G. H. Carpenter. The present considerable additions to the Hawaiian fauna are due mostly to the active interest of Mr. R. H. Van Zwaluwenburg.

Most of the type material upon which this paper is based has been deposited with the Hawaiian Entomological Society, Honolulu. In addition, specimens of most of the species have, by permission, been given to the U. S. National Museum.

A considerable proportion of these Hawaiian forms have their nearest allies in the East Indies, India and China, and a few of the species are cosmopolitan in distribution.

At present it is impossible to name species of Collembola as being endemic to the Hawaiian Islands, on account of our insufficient knowledge of the collembolan faunae of other regions. The non-endemic species may have been brought to the Islands by natural or by artificial means. Some idea of the extent to which Collembola are distributed commercially (most commonly in shipments of plants or plant products, and especially in soil) may be gathered from the fact that the Plant Quarantine and Control Administration (formerly the Federal Horticultural Board) has intercepted, through its inspectors at ports of the United States, thousands of specimens of Collembola, representing hundreds of species; these from all parts of the world.

In the descriptions that follow a few often-used expressions have been abbreviated. *Ant. 1,* for example, means the first an-

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tennal segment; *th. 2,* the second thoracic segment; *abd. 3,* the third abdominal segment.

The keys that follow are limited in scope to the known species of Hawaiian Collembola, including those described by Carpenter.

SYNOPSIS OF THE LARGER GROUPS OF THE ORDER COLLEMBOLA

1. Body elongate, segmentation evident. Suborder ARTHROPLEONA 2

   Body globular, segmentation obscure. Suborder SYMPHYPLEONA 9

2. Body segments essentially similar; prothorax similar to the other segments and with setae dorsally; never reduced or naked. Postantennal organ usually present. Antennae short, four-segmented. Mouth parts biting or piercing-suctorial. Unguiculus frequently absent. Furcula present or absent; when present, clearly appended to the fourth abdominal segment. Manubrium without setae ventrally. Anal spines often present. Integument tuberculate, weak, not hardened in the form of sclerites. Scales absent. Family PODURIDAE 3

   Body segments usually dissimilar; prothorax usually reduced, always membranous, without dorsal setae, and usually partly or entirely covered by the mesonotum. Postantennal organs present in Isotominae, absent in the other groups. Antennae usually long, four to six segmented. Mouth parts biting, Furcula present with few exceptions, often appended apparently to the fifth abdominal segment. Manubrium usually with setae or scales ventrally. Anal spines rarely present. Integument usually smooth, and hardened to form sclerites. Tergites usually imbricate. Scales present or absent. Family ENTOMOBRYIDAE 6

3. Head and body without pseudocelli. Eyes present or absent. Postantennal organ usually present. Unguiculus present or absent. Furcula present or absent. Sense organ of ant. 3 with sense rods, but without sense clubs and outer papillae 4

   Head and body with pseudocelli. Eyes absent. Postantennal organs almost always present and well developed. Mouth parts biting; mandibles with molar surface. Furcula absent or rudimentary. Sense organ of ant. 3 with sense rods, sense clubs, and often with outer papillae with guard setae. Anal spines usually present. Subfamily ONYCHIURINAE ..... p. 57

4. Mouth parts biting, not projecting in a cone; mandibles with molar surface. Furcula present. Anal spines usually present. Subfamily ACHORUTINAE ..... p. 53

   Mouth parts biting or piercing-suctorial, projecting in a cone in most of the genera; mandibles small or absent, without molar surface. Subfamily NEANURINAE 5

5. Anal segment relatively small; supra-anal valve rounded, not bilobed. Furcula present or absent. Segmental tubercles absent. Tribe PSEUDACHORUTINI ..... p. 55

Anal segment relatively large; supra-anal bivalve bilobed. Unguiculus absent. Furcula absent. Segmental tubercles present. Buccal cone present. Anal spines absent. Tribe NEANURINI....., p. 56

6. Postantennal organs almost invariably present (absent in *Isotoma minor*). Third and fourth abdominal segments not greatly different in median dorsal length. Mesonotum not projecting over the head. Inner margin of unguis simple. Scales absent. Body setae simple; occasionally unilaterally feathered. Subfamily ISOTOMINAE ....., p. 58

Postantennal organs absent. Fourth abdominal segment much longer than the third. Mesonotum often projecting over the head. Inner margin of unguis split. Scales present or absent. Body setae of various types, including setae finely fringed on all sides. Subfamily ENTOMOBRYINAE..... 7

7. Dentes slender, dorsally annulated. Mucro short, relatively small, with apical tooth, anteapical tooth and basal spine; or falcate. Tribe ENTOMOBRYINI ....., p. 64

Dentes not dorsally annulated..... 8

8. Dentes without two rows of dorsal feather-like scales. Mucro robust, with dissimilar inner and outer margins. Antennae unusually long. Eyes present. Tribe PARONELLINI....., p. 71

Dentes with two rows of dorsal feather-like scales. Mucro elongate, slender, with similar margins. Antennae relatively short. Eyes absent. Scales present. White species. Tribe CYPHODERINI ....., p. 71

9. First four abdominal segments ankylosed. Antennae inserted on the posterior half of the head, and longer than the head. Family SMINTHURIDAE 10

10. Vesicles of ventral tube with smooth walls. Thoracic segmentation indicated dorsally. Subfamily SMINTHURIDINAE....., p. 72

Vesicles of ventral tube with tuberculate walls. Thoracic segmentation absent..... 11

11. Antennae bent between segments three and four. Ant. 4 longer than ant. 3, and subsegmented. Subfamily SMINTHURINAE....., p. 73

Antennae bent between segments two and three. Ant. 4 shorter than ant. 3; both, or only the fourth segment, subsegmented. Subfamily DICYRTOMINAE....., p. 74

Subfamily ACHORUTINAE Börner

KEY TO GENERA

Furcula well developed. Eyes sixteen. Postantennal organs present. .....SCHÖTTELLA, p. 54

Furcula small. Eyes ten. Postantennal organs absent.....XENYLLA, p. 54

Genus SCHÖTTELLA Schäffer

Schöttella alba new species. (Plate 1, figs. 1-4).

White. Eyes (fig. 1) remote from antennae, eight on each side, equal, distant from one another, without pigment. Postantennal organ (fig. 1) with five subequal lobes, forming a rosette. Mandibles present, with well-developed molar surfaces. Antennae shorter than the head, with several olfactory setae (fig. 2). Unguis (fig. 3) untoothed. Unguiculus absent. Tenent hairs absent. Dens (fig. 4) with three dorsal setae. Mucro (fig. 4) about one-third as long as dens, stout, in lateral aspect rounded apically, with broad rounding inner lamella. Anal spines absent. Clothing of very few short stiff setae, in two transverse rows on most of the body segments. Integument tuberculate. Length, 0.8 mm.

Honolulu, October 8, 1927, from pineapple roots (J. F. Illingworth).

Genus XENYLLA Tullberg

Xenylla sensilis new species. (Plate 1, figs. 5-13).

Dorsally mottled with blue pigment; ventrally pale. Eyes (fig. 5) five on each side, on black patches. Postantennal organs absent. Antennae shorter than the head (as 9:13). Ant. 3 organ (fig. 6) with a pair of clavate papillae under a tuberculate, rounded, integumentary fold and between a pair of slightly curving accessory horns, each of which is subtended by a seta. Ant. 4 with distal sensory cones as in figure 7. Unguis (fig. 8) apparently unidentate in lateral aspect; actually with a pair of teeth side by side as in figure 9. Tenent hairs 1, 2, 2. Anal spines (fig. 10) minute. Dens (fig. 11) with two dorsal setae. Mucro (figs. 11, 12) seven-tenths as long as dens, distally produced and slightly curving, apically rounded; lamella broad, terminating before the apex. Rami of tenaculum tridentate. Body setae (fig. 13) few, minute, simple. Integument tuberculate. Length, 0.8 mm.

This species is near *X. welchi* Folsom (1916, p. 497) from which it differs chiefly in the structure of the antennal sense organs.

Honolulu, October 4, 1928, pineapple soil (J. F. Illingworth).

Xenylla alba new species. (Plate 2, figs. 14-20).

White. Eyes (fig. 14) five on each side, on black spots; ocular pigment sparse. Postantennal organs absent. Antennae two-thirds as long as the head. Ant. 3 organ (fig. 15) with a pair of elongate rods and two guard setae. Ant. 4 with distal sensory cones as in figure 16; olfactory setae slender, curving, not much differentiated from the other setae. Unguis (fig. 17) stout, curving, untoothed. Tenent hairs 1, 2, 2. Anal spines (fig. 18) minute. Dens with two setae. Mucro (figs. 19, 20) from one-half to three-fourths as long as dens, distally produced and curving upward, apically rounded; inner lamella broad, ending before the apex. Body setae very few, minute, curving, simple. Integument tuberculate. Length, 0.8 mm.

Honolulu, October 8, 1927, among pineapple roots (J. F. Illingworth).

Tribe PSEUDACHORUTINI Börner

Genus STACHIA new genus

(Plate 2, figs. 21-26; Plate 3, figs. 27-30)

Elongate, minute. Eyes reduced in number. Postantennal organ trilobed. Antennae shorter than the head, conical, four-segmented. Ant. 4 with a terminal sensory tubercle. Buccal cone present. Mouth parts piercing. Body segments not demarcated from one another by sutural lines. Prothorax not reduced. Anal segment simple, rounded; anus caudal; anal valves subtriangular in outline. Unguiculus absent. Furcula rudimentary. Integument tuberculate. Large segmental tubercles absent. Genotype, *Stachia minuta* Folsom.

This generic description, being based on a single species, may need future modification.

This peculiar genus belongs in Pseudachorutini but comes close to none of the described genera of that tribe. Its trilobed postantennal organs are like those of Xenyllodes and its mandibles and maxillae are similar in plan to those of Micranurida (Börner, 1901, p. 703). The maxilla is exactly like that of *Neanura* (*Achorutes*) *muscorum* (Folsom, 1916, pl. 23, fig. 225) except in having a relatively shorter head.

On the whole, the genus may be placed near Micranurida.

This new genus is named for Dr. Jan Stach, the esteemed Polish authority on Collembola.

Stachia minuta new species. (Plate 2, figs. 21-26; Plate 3, figs. 27-30).

White throughout, elongate (fig. 21), minute, with intersegmental grooves instead of sutures. Eyes consisting of a single cornea on each side of the head, close to the base of the antenna (fig. 22) and without pigment. Close to each eye is the trilobed postantennal organ (fig. 23) situated in a pit formed by an integumentary ridge. Antennae less than half as long as the head, stoutly conical, four-segmented. Ant. 4 with a terminal sensory tubercle; special olfactory setae absent. Buccal cone present, broadly triangular in ventral aspect. Mouth parts piercing; mandible distally (fig. 24) semi-sagittate, with a sharply pointed apex and a sharp subapical barb like that of a fishook; secondary teeth absent; maxilla (fig. 25) with a simple piercing apex. Body segments in relative lengths about as 12 : 20 : 18 : 14 : 13 : 12 : 13 : 11 : 8; prothorax relatively large; anal segment (fig. 26) simple, rounded, without anal spines; anus caudal; anal valves (fig. 27) subtriangular in outline. Legs short and stout. Unguis (fig. 28) stout, subfalcate, untoothed. Unguiculus absent. Tenent hairs absent. Ventral tube small, with a pair of hemispherical vesicles side by side. Furcula present but greatly reduced (figs. 29, 30), being a simple bilobed organ in

which manubrium, dentes and mucrones are not demarcated from one another. Tenaculum apparently absent. Body setae very few, minute, short and stiff, in a single row across the middle of most of the body segments, being rather numerous and larger on the genital and anal segments. Integument tuberculate, the tubercles becoming larger and irregular on the genital and anal segments. Large segmental tubercles absent. Length, 0.5 mm.

Wahiawa, Oahu, July 12, August 12, October 2, 4, 1928, abundant deep in pineapple soil with Onychiurus, Japyx, Symphyla, etc. (J. F. Illingworth); Honolulu, in many soil samples (R. H. Van Zwaluwenburg); Tantalus, Oahu, August 4, 1930, soil in native forest, 1700 ft. (R. H. Van Zwaluwenburg and F. A. Bianchi).

Cotypes.—Cat. No. 43764, U. S. N. M.

Tribe NEANURINI Börner

KEY TO GENERA

Head of maxilla with toothed lamellae.....PROTANURA
Head of maxilla needlelike, without lamellae.....NEANURA

Genus PROTANURA Börner

Protanura capitata new species. (Plate 3, figs. 31-36).

White (fig. 31). Head with a postero-lateral tubercle on each side. Eyes and postantennal organs absent. Antennae a little shorter than the head. Ant. 3 and 4 confluent dorsally but demarcated by a suture ventrally. Ant. 3 organ (fig. 32) simple, with a pair of ovate papillae. Ant. 4 with distal olfactory setae as in figure 33. Buccal cone present. Mandible distally (fig. 34) with large teeth, laciniate appendage and long linear stalk. Head of maxilla (fig. 35) with coarsely toothed galea and finely toothed lacinial membranes. Segmental tubercles in dorsal aspect: 6, 8, 8, 8, 8, 8, 6, 4, 2; the dorsal tubercles much less prominent than in figure 31. Unguis (fig. 36) with a pair of inner teeth side by side, one-third from the base. Tenent hairs absent. Anal spines and furcula absent. Anus ventral. Clothing of short simple setae and long capitate hairs. Integument tuberculate, not reticulate. Length, 3 mm.

This species is quite distinct from the four other species of Protanura.

Honolulu, September 13, 1930 (Walter Carter).

Genus NEANURA MacGillivray

Neanura citronella Carpenter.
See Carpenter, 1904, p. 303.

Subfamily ONYCHIURINAE Börner

KEY TO GENERA

Body stout or moderately slender, head broad. Tubercles of postantennal organ usually not numerous. Sense clubs of ant. 3 smooth or tuberculate, not bending toward each other. Unguiculus well developed. ..... ONYCHIURUS

Body quite slender, head narrow. Tubercles of postantennal organ usually numerous. Sense clubs of ant. 3 smooth, bending toward each other. Unguiculus reduced and setaceous, or absent..... TULLBERGIA

Genus ONYCHIURUS Gervais

Onychiurus fimetarius (L., Lubb.).

For a description of this species see Folsom, 1917, p. 649.

The Hawaiian specimens of this species agree accurately with examples from Europe and North America. The species, common throughout Europe and widely distributed in North America, is known also from Algeria, Sumatra, and China.

Olaa, Hawaii, soil in sugar cane fields (R. H. Van Zwaluwenburg).

Genus TULLBERGIA Lubbock

Tullbergia silvicola new species. (Plate 4, figs. 37-41).

White. Slender (fig. 37), six times as long as broad. Postantennal organs (fig. 38) subelliptical, each with about 60 tubercles. Pseudocelli large, thick-walled. Head with a pseudocellus just in front of each postantennal organ. Antennal base not differentiated. Antennae two-thirds as long as the head; third and fourth segments confluent. Ant. 3 organ (fig. 39) with four guard setae, two minute sense rods, and two subreniform smooth sense clubs curving toward each other. Ant. 4 with six or more strongly curving olfactory setae. Body with a pair of dorsal pseudocelli on segments th. 2 to abd. 5, inclusive (fig. 37). Unguis (fig. 40) stout, curving, untoothed. Unguiculus rudimentary, spiniform. Anal spines (fig. 41) two, slender, arcuate, four-fifths as long as hind unguis, on contiguous papillae. Clothing of minute stiff simple setae; the sensory setae longer. Integument tuberculate. Length, 0.7 mm.

In the pseudocelli of the head the wall is often interrupted, as in figure 38.

Tantalus, Oahu, August 4, 1930, soil in native forest, 1700 ft. (R. H. Van Zwaluwenburg and F. A. Bianchi).

Subfamily ISOTOMINAE Börner

KEY TO GENERA

1. Body cylindrical, greatly elongate. Prothorax unusually long. Abd. 4 a simple ring. Terga not imbricate. Furcula very small. Eyes reduced in number or absent. Postantennal organs long and narrow. Manubrium longer than dentes 2
   Body not greatly elongate. Prothorax reduced more or less. Abd. 4 modified. Terga imbricate. Furcula not very small 3
2. Genital and anal segments simple, or relatively unmodified, without ankylosis. Anus not ventral. Manubrial hooks not strongly developed. Integument smooth ..... FOLSOMIDES, p. 58
   Genital and anal segments modified, shortened, ankylosed. Anus ventral. Manubrial hooks strongly developed. Integument granulate. ..... ISOTOMODES, p. 59
3. Last three abdominal segments ankylosed, forming a single mass. Anus ventro-caudal. Eyes reduced in number or absent. Body pigment weak or absent 4
   Last three abdominal segments not ankylosed. Anus caudal. Eyes usually sixteen. Pigment commonly well developed 5
4. Mucro bidentate. Ant. 4 without sense clubs ..... FOLSOMIA, p. 60
   Mucro falcate. Ant. 4 with sense clubs ..... DENISIA, p. 61
5. Third abdominal tergite shorter than the fourth, and not ventrolaterally prolonged backward. Furcula not attaining the ventral tube. ..... PROISOTOMA, p. 62
   Third abdominal tergite longer than the fourth, and ventrolaterally prolonged backward. Furcula attaining the ventral tube 6
6. Abdominal fringed bothriotricha present. Mucrones lamellate. ..... ISOTOMURUS, p. 63
   Bothriotricha absent. Mucrones not lamellate ..... ISOTOMA, p. 63

Genus FOLSOMIDES Stach

Folsomides exiguus new species. (Plate 4, figs. 42-47).

White. Greatly elongate (fig. 42). Eyes two on each side, pigmented separately, one behind the other, the posterior eye being the smaller. Postantennal organ (fig. 43) near the anterior eye, elongate, six to seven times as long as broad, feebly curving, with three or four posterior guard setae; from two-thirds to one and one-third times as long as the basal width of ant. 1. Antennae two-thirds as long as the head, with stout segments in relative lengths about as 16 : 24 : 25 : 42. Sense organ of ant. 3 with a pair of papillae, each arising from the bottom of a deep pit. Ant. 4 with several slender curving olfactory setae, without terminal tubercle. Mandible with a molar surface (fig. 44). Body segments in relative lengths about as 9 : 32 : 27 : 23 : 23 : 23 : 25 : 18 : 17; or 10 : 34 : 28 : 20 : 23 : 24 : 29 : 20 : 18. Body segments without ankylosis. Anus caudal. Unguis (figs. 45, 46) stout, curving, simple, untoothed. Unguiculus of hind feet (fig. 45) lanceolate, acuminate, extending about one-fourth as far as the unguis; on fore and mid-feet, a minute pointed rudiment (fig. 46). Tenent

hairs absent. Ventral tube with a pair of hemispherical vesicles, side by side. Furcula small, appended evidently to abd. 4, and extending only slightly beyond the anterior border of that segment. Manubrium (fig. 47) stout, with four pairs of dorsal setae, without ventral setae. Mucrodentes (fig. 47) three-fourths or three-fifths as long as manubrium, with three dorsal setae, no ventral setae, and minutely bidentate: apical tooth hooked; anteapical tooth larger, erect or inclined slightly forward. Rami of tenaculum tridentate; corpus with a small median anterior lobe and one seta. General clothing of a few rows of short stiff simple setae in the middle region of most of the body segments; sensory setae longer, erect, simple. Integument smooth. Maximum length, 0.7 mm.

This new species differs in many respects from the genotype, *F. parvulus* Stach (1922, p. 17), from Hungary.

Honolulu, March 25, 1925, in sugar cane soil; November 26, 1928, in rice soil (R. H. Van Zwaluwenburg); October 8, 1927, in pineapple soil (J. F. Illingworth); Tantalus, Oahu, August 4, 1930, in soil in native forest, 1700 ft. (R. H. Van Zwaluwenburg and F. A. Bianchi).

Cotypes.—Cat. No. 43765, U. S. N. M.

Genus Isotomodes Axelson

Isotomodes denisi new species. (Plate 5, figs. 48-56).

White throughout. Very elongate (fig. 48). Eyes absent. Postantennal organs (fig. 49) elliptical, three times as long as wide, three-fourths as long as the basal width of ant. 1, with guard setae as in figure 49, there being none near the anterior border of the organ. Antennae slightly longer than the head, with segments about as 4 : 5 : 6 : 9. Sense organ of ant. 3 consisting of a pair of sacs, the walls of which are circular in deep optical cross-section (fig. 50), and shaped like the figure 8 at the level of the integument (fig. 51). Each sac contains a single papilla (fig. 52) and is covered externally by a hemispherical tubercle. Ant. 4 with several (at least 5) curving olfactory pegs (fig. 52), without a terminal tubercle and without a subapical papilla. Mandibles and maxillae as in figures 53 and 54. Prothorax relatively long. Genital and anal segments ankylosed, with a short obsolete dorsal suture. Body segments in relative lengths about as 9 : 22 : 20 : 14 : 13 : 16 : 20 : 5+6. Anus ventral. Femora with a partial distal subsegment, the transverse suture being limited to the lower side of the femur. Unguis (fig. 55) stout, almost straight, untoothed. Unguiculus extending almost half as far as the unguis, oblong-lanceolate and acute on the hind feet, smaller and more sharply pointed on the other feet. Tenent hairs absent. Ventral tube with a pair of rounded vesicles side by side. Furcula small, extending only to the middle of abd. 3. Manubrium stout, longer than dentes (as 4 : 3 or 5 : 3), ventrally naked, dorsally with many stiff setae (20 or more). Manubrial hooks strongly developed (fig. 56). Dens (fig. 56) not annulate; dorsally with only two setae, situated near the base of the dens and erect, the proximal

seta long and strong, and the distal seta much smaller; dens ventrally with only one seta as a rule, rarely with two or three; manubrial hooks strongly developed. Mucrones (fig. 56) one-third as long as dentes, three-quarters as long as hind ungues, bidentate; anteapical tooth larger than the apical. Rami of tenaculum tridentate; corpus with one strong curving anterior seta. General clothing of a few rows of short stiff simple setae across the middle region of a body segment, being abundant and stronger at the end of the abdomen; sensory setae longer, erect, simple, in a single transverse row on most of the body segments. Integument smooth. Maximum length, 1.7 mm.

This species differs in several respects from *Isotomodes productus* Axels., known from Finland, Russia, France, England and Morocco. *I. productus* (Linnaniemi, 1912, p. 107; Denis, 1923, p. 243; Handschin, 1925*a*, p. 164) is described as having at least 14 or 15 olfactory setae on ant. 4; postantennal organ longer than the basal width of ant. 1, and with 6 posterior and 3 anterior guard setae; abd. 3 and 4 equal in length; dens with only one ventral seta; mucro one-fourth as long as dens; integument granulate.

A variety of *productus* was named *trisetosa* by Denis on account of its having three ventral setae on each dens. In this new species different individuals may show one, two, or three such setae, though only one as a rule.

Honokaa, Hawaii, November 5, 1928, in cane soil; Honolulu, abundant in cane soil (R. H. Van Zwaluwenburg); Tantalus, Oahu, August 4, 1930, in soil in native forest, 1700 ft. (R. H. Van Zwaluwenburg and F. A. Bianchi).

This new species is named for Dr. J. R. Denis, known for his exact and thorough studies of Collembola.

Cotypes.—Cat. No. 43766, U. S. N. M.

Genus Folsomia Willem

Folsomia fimetaria (L., Tull.).

My Hawaiian specimens of this species agree with European and North American examples except in having stouter ungues. The postantennal organs, very variable in form and size in this species, are narrowly subelliptical and about as long as the basal width of ant. 1. The specimens are all young individuals, being only 1 mm. in length.

For a description of this species see Folsom, 1902, p. 92.

This cosmopolitan species belongs to the fauna of the soil, being often found among the roots of plants, under damp wood, stones or bark, in moss, and not infrequently on well water. It occurs often in flowerpots in dwelling houses or greenhouses, having been brought in with the soil; and has been found in caverns and graves.

F. fimetaria is one of the commonest collembolans in northern and middle Europe and in the United States, in all parts of which it occurs, including California and Alaska. It is known also from Siberia, Spitzbergen, Franz Josef Land, Greenland, Mexico and Guatemala. It has often been intercepted in ports of this country by inspectors of the Plant Quarantine and Control Administration.

Honokaa and Olaa, Hawaii, soil in sugar cane fields (R. H. Van Zwaluwenburg).

Genus DENISIA new genus

(Plate 5, fig. 57; Plate 6, figs. 58-62)

Fourth, fifth, and sixth abdominal segments ankylosed, forming a single mass. Anus ventro-caudal. Mucrones falcate. Eyes and postantennal organs absent. Ant. 4 with relatively large sense clubs. Unguis and unguiculus untoothed. Tenent hairs absent. Body setae simple. Integument smooth. Genotype, *Denisia falcata* Folsom.

This new genus is evidently close to *Folsomia* Willem, from which it differs chiefly in having falcate mucrones and antennal sense clubs and in lacking postantennal organs. I dedicate it with pleasure to my colleague, Dr. J. R. Denis.

Denisia falcata new species. (Plate 5, fig. 57; Plate 6, figs. 58-62).

White (fig. 57). Eyes and postantennal organs absent. Antennae subequal to head in length, to one-fourth longer than head. Ant. 3 organ with a pair of small tubercles in a shallow depression. Ant. 4 with five or six distal dorso-lateral sense clubs (fig. 58) and a terminal tubercle. Mandibles with a well developed molar surface. Imbrication of body segments weak. Abd. 4, 5, and 6 ankylosed, without sutures in some individuals, but usually with an obsolete dorsal suture between abd. 4 and 5. Anus ventro-caudal. Unguis (fig. 59) simple, untoothed. Unguiculus extending about one-half as far as the unguis, broadly lanceolate, acute, untoothed. Knobbed tenent hairs absent. Furcula extending not quite to the ventral tube. Manubrium ventrally with five pairs of distal setae. Manubrial hooks not developed; there being two pairs of narrow chitinous ridges. Dens (fig. 60) slightly more than twice as long as manubrium, slender, tapering, crenulate dorsally on proximal half only; with very long ventral subapical seta; basodorsally with a long erect seta just anterior to a short seta. Mucrones (fig.

61) falcate. Rami of tenaculum quadridentate; corpus with one anterior seta, sometimes a pair of setae. Clothing (fig. 62) of abundant, short, stiff, simple setae, with long erect simple sensory setae; with a few long unilaterally fringed setae on the ankylosed abdominal segments. Integument smooth. Length, 0.65 mm.

Honolulu, January 7, 1927, in cane soil. April 5, 1927, from débris in nest of *Coptotermes formosanus* Shiraki (R. H. Van Zwaluwenburg).

Cotypes.—Cat. No. 43767, U. S. N. M.

Genus Proisotoma Börner

Proisotoma nigromaculosa new species. (Plate 6, figs. 63-66).

White, minutely and irregularly flecked with blackish blue, giving a pale grayish appearance. Antennae bluish throughout, or spotted with blackish; ant. 4 dark apically. Legs white with pigmented coxae, or spotted throughout with blackish. Furcula unpigmented. Antennae subequal to head in length, or slightly longer, with segments about as 4 : 5 : 6 : 9 or 7 : 13 : 12 : 23. Ant. 3 organ with a pair of simple rods subtended by a chitinous ridge. Ant. 4 with a terminal sensory tubercle and without specially differentiated olfactory setae. Eyes eight on each side (fig. 63), subequal, on black patches. Postantennal organ elliptical to subreniform, with or without an anterior notch at the middle, and three to three and one-half times as long as the diameter of an adjacent eye. Abd. 3 shorter than abd. 4 (as 5 : 6). Genital and anal segments usually not ankylosed, sometimes partially ankylosed. Tibiotarsi with an incomplete distal subsegment, indicated by a suture on the lower side. Unguis (fig. 64) untoothed. Unguiculus sublanceolate, untoothed, or with an inner tooth or angle, and extending from almost one-half to two-thirds as far as the unguis. Tenent hairs absent. Furcula not attaining the ventral tube; extending to the middle of abd. 2. Manubrium with one pair to three pairs of ventral subapical setae. Dentes one-third longer than manubrium, with coarse transverse dorsal folds, absent proximally and distally. Mucro (figs. 65, 66) subequally bidentate. Rami of tenaculum quadridentate; corpus with one anterior seta. Clothing of short, stiff, simple setae in the middle region of most of the body segments, absent in the intersegmental regions, with longer erect simple sensory setae. Integument smooth. Length, 0.9 mm.

This species is somewhat like the European *Proisotoma ripicola* Linnaniemi (1912, p. 128), from which it differs, however, in coloration, in having relatively much longer dentes, and in several other details.

Pupukea, Oahu, October 1, 1928, in pineapple soil (J. F. Illingworth); Honolulu, November 26, 1928, in rice soil (R. H. Van Zwaluwenburg).

Genus Isotomurus Börner

Isotomurus palustris (Müller), var. **balteatus** (Reuter).

The Hawaiian examples of this variety are typical in structure and coloration. For a description, see Schött, 1894, p. 66.

I. palustris is a common cosmopolitan species, highly variable in coloration. Its variety *balteatus* is known from Europe, many parts of the United States, including California, and from British West Indies and Bismarck Archipelago.

Honolulu, sugar cane soil, near the surface under trash, "78 per surface square foot" (R. H. Van Zwaluwenburg); Kauai, soil in sugar cane fields (R. H. Van Zwaluwenburg).

Genus Isotoma Bourlet

KEY TO SPECIES

Purplish yellow. Eyes sixteen. Tenent hair one.....*perkinsi*
White. Eyes, postantennal organs, and tenent hairs absent.....*minor*

Isotoma perkinsi Carpenter.

See Carpenter, 1904, p. 302.

Isotoma minor Schäffer. (Plate 6, figs. 67-71).

White throughout. Eyes and postantennal organs absent. Antennae about one-fourth longer than the head, with segments about as 3 : 7 : 7 : 10; third and fourth segments subclavate. Ant. 4 with six or seven relatively large olfactory cones or pegs, as in figures 67 and 68. Abd. 3 usually a little shorter than abd. 4 (as 9 : 11); sometimes subequal to it. Abd. 5 and 6 usually, but not always, ankylosed; anal valves large. Unguis (fig. 69) rather slender, untoothed. Unguiculus extending two-thirds as far as the unguis on the hind feet; about half as far on the remaining feet; broadly lanceolate, acute, untoothed. Tenent hairs absent. Furcula extending not quite to the ventral tube. Manubrium with several stiff dorsal setae and four to ten ventral subapical setae. Dens two and one-half times as long as manubrium, with a few erect dorsal setae and stiff oblique ventral setae; dorsally minutely crenulate on the proximal four-sevenths only. Mucro (fig. 70) tridentate; apical tooth slender; anteapical tooth erect; basal tooth lateral, spinelike; dens with a long lateral subapical seta. Rami of tenaculum quadridentate; corpus with one anterior seta. General clothing of rather long, stiff or curving, simple setae (fig. 71); outstanding sensory setae of abdominal segments much longer, doubly fringed, stronger on the posterior region of the abdomen. Length, 0.91 mm.

The Hawaiian examples of *I. minor* agree with European and North American representatives of the species in every detail except that in the Hawaiian specimens ant. 1 is relatively shorter, and the baso-lateral tooth of the mucro is slender and spinelike instead of being short and blunt.

I. minor, a species of the soil fauna, has been recorded from almost all parts of Europe, from the United States and from Mexico.

Honolulu, January 7, 1927, in cane soil (R. H. Van Zwaluwenburg).

Tribe ENTOMOBRYINI Börner

KEY TO GENERA

1. Body without scales 2
   Body with scales 3
2. Ungues with simple inner teeth. Tenent hair strongly developed. ..... ENTOMOBRYA, p. 64
   Ungues with large inner "wing-teeth." Tenent hair weak. ..... SINELLA, p. 66
3. Scales pointed apically, with long coarse striae. Dentes without scales. ..... SIRA, p. 66
   Scales rounded apically, with short fine close striae. Antennae not annulated 4
4. Mucro with two teeth and a basal spine ..... LEPIDOCYRTUS, p. 67
   Mucro falcate. ..... DREPANOCYRTUS, p. 69

Genus ENTOMOBRYA Rondani

KEY TO SPECIES

1. White throughout ..... *lactea,* p. 65
   Yellow with purple markings 2
2. Transversely banded ..... *multifasciata,* p. 64
   Not banded 3
3. Yellow with lateral purple stripes. Tenent hair present. Mucro with basal tooth ..... *insularis,* p. 64
   Yellow with complex purple markings. Tenent hair and basal tooth absent ..... *kalakaua,* p. 64

Entomobrya insularis Carpenter.
See Carpenter, 1904, p. 301.

Entomobrya kalakaua Carpenter.
See Carpenter, 1904, p. 301.

Entomobrya multifasciata (Tullberg), var. **imminuta** new variety. (Plate 7, figs. 72-75).

Yellow with transverse bands (fig. 72). The pigment is purple, appearing black where it is dense. Prothorax pigmented dorsally; mesonotum with an anterior band extending laterally, and a posterior marginal band; metanotum with a posterior band and a lateral marginal spot; first three abdominal segments each with a broad posterior band; abd. 4 with two dorsal bands, the posterior one being marginal; abd. 5 with a posterior

band; abd. 6 pigmented dorsally. Head with an irregular median frontal spot; behind this a V-shaped mark; occiput with a dorsal marginal mark. Antennal base blackish; ant. 1 and 2 each with an apical spot; ant. 3 dull purplish except basally; ant. 4 dull purplish throughout. First pair of legs unpigmented except on the precoxae; second and third pairs each with precoxal spots and a distal femoral spot. Furcula unpigmented. Eyes (fig. 73) sixteen, the two inner proximal eyes of each side smaller than the others. Antennae more than twice as long as the head. Body segments (omitting the prothorax) in relative lengths about as 20 : 21 : 19 : 18 : 19 : 25 : 12 : 7 or as 28 : 23 : 17 : 22 : 20 : 47 : 13 : 9. Unguis (fig. 74) stout, almost straight; inner border with a pair of large proximal teeth one-third from the apex, and a smaller distal pair. Unguiculus oblong-lanceolate, extending about two-thirds as far as the unguis. Tenent hair about as long as the unguis. Dentes slightly longer than the manubrium, the dorsal crenulations ending at a distance from the apex equal to three times the length of the mucro. Mucro (fig. 75) in lateral aspect strongly rounded ventrally, the anteapical tooth relatively low and broadly conical. Rami of tenaculum quadridentate; corpus with one strong curving anterior seta. Length, 1.6 mm.

In coloration this form agrees essentially with *multifasciata* Tull., a common species in Europe and North America. As compared with typical *multifasciata,* however, abd. 4 is relatively much shorter; the antennae relatively much longer; the proximal pair of teeth of the unguis is beyond the middle; and the two inner proximal eyes of each side are greatly reduced.

The posterior marginal bands of th. 2 to abd. 3, inclusive, are either continuous or else more or less interrupted along the median dorsal line—a variation that is common in *multifasciata,* both in Europe and North America.

In one individual the mid intestine contained an abundance of fungus spores and fragments of hyphae, the latter predominating.

Pupukea, Oahu, October 1, 1928, in pineapple soil (J. F. Illingworth).

Entomobrya lactea new species. (Plate 7, figs. 76-78).

Head and body usually white throughout, excepting the black eye spots and frontal ocellus. The largest individuals may have a narrow weak posterior purple band on abd. 1, 2, 3, 5 and 6. Ant. 1 and 2 purple apically, or ant. 1 unpigmented; ant. 3 pigmented apically or throughout; ant. 4 purple throughout. Femora pigmented apically; tibiotarsi throughout. Furcula unpigmented. Eyes (fig. 76) sixteen, unequal. Antennae four-fifths longer than the head, with segments about as 12 : 23 : 24 : 28, not annulated. Abd. 4 is two and one-half to three and one-half times as long as abd. 3. Unguis (fig. 77) slender, with two pairs of inner teeth and a pair of lateral teeth. Unguiculus extending about five-eighths as far as the unguis, oblong-lanceolate, acute, untoothed. Tenent hair equal to unguis in

length. Manubrium three-fifths as long as dentes. The non-annulated region of the dens is about one and two-thirds times as long as the mucro. Mucro (fig. 78) minute; apical and anteapical teeth hooked, subequal: basal spine present. Length, 1.3 mm.

Honolulu, September, 1930, behind sugar cane leaf sheaths, in trash, etc. (F. X. Williams).

Cotypes.—Cat. No. 43768, U. S. N. M.

Genus Sinella Brook

Sinella höfti Schäffer. (Plate 7, figs. 79-81).

White. Eyeless. Antennae longer than the head (as 8 : 5). Abd. 4 two and one-fourth to two and two-thirds times as long as abd. 3. Unguis (fig. 79) with a large acute basal "wing-tooth," posterior in position, (when the leg is in a transverse plane); opposite this is an anterior linear thickening, which may or may not be pointed distally; just beyond this is either a tooth or an angle. A pair of small pseudonychia occurs near the base. Unguiculus extending two-thirds to four-fifths as far as unguis, with a large acute outer wing-tooth. Tenent hair as long as inner margin of unguis, not clubbed. On each tibiotarsus, one-third from the base, is a large subclavate fringed seta (fig. 80). Furcula with scales ventrally. Dens one-fifth longer than manubrium. Mucro (fig. 81) stout, falcate, with long basal spine. Length, 1.1 mm.

The specimens studied were not full grown.

The thickened fringed seta of the tibiotarsi I find in specimens from Iowa also.

As compared with European examples, the wing-tooth of the unguis is wider, and the opposite, or anterior, tooth is greatly narrowed or reduced to a ridge.

This species is known from China (Denis, 1929*b*, p. 311) and a variety of it (*S. coeca edenticulata*) has been described from Java (Handschin, 1926, p. 455). I think that *S. montana* Imms (1912, p. 101) from India is to be regarded as a variety of *höfti*.

Tantalus, Oahu, August 4, 1930, in soil in native forest, 1700 ft. (R. H. Van Zwaluwenburg and F. A. Bianchi).

Genus Sira Lubbock

Sira jacobsoni Börner. (Plate 8, figs. 82-88).

When denuded of scales, yellow or whitish, marked with blackish purple (figs. 82, 83). Mesonotum pigmented throughout, or nearly so, the band extending to the bases of the coxae. Abd. 2 with a posterior band, sometimes narrow and somewhat irregular (fig. 83). Abd. 3 banded throughout dorsally, or with a narrow anterior unpigmented area. Abd. 4 banded

posteriorly; the band sometimes covering more than half of the dorsum, and always having an irregular anterior margin, often with irregular streaks of pigment projecting forward. Abd. 5 with a postero-dorsal spot, or unpigmented. Head with a median frontal spot, indicating the ocellus. Ant. 1 yellow or white, purple apically; ant. 2 purple apically or throughout; ant. 3 and 4 purple. Fore legs with femur pigmented apically and tibiotarsus pigmented near the middle; middle and hind legs with spots of pigment on the precoxae, the femur apically, and the tibiotarsus beyond the middle. Furcula unpigmented. Eyes (fig. 84) sixteen, unequal, the two inner proximal eyes of each side being small and difficult to distinguish. Antennae a little more than twice as long as the head, with segments about as 12 : 28 : 30 : 41, or 8 : 19 : 16 : 27. Mesonotum not projecting over the base of the head. Abd. 4 about 2.2 to 2.4 times as long as abd. 3. Unguis (figs. 85, 86) with three inner pairs of teeth and a pair of lateral teeth. Unguiculus extending about two-thirds as far as the unguis, oblong-lanceolate. Tenent hair a little longer than unguis. Dens one-fourth longer than manubrium, its dorsal crenulations ending before the apex at a distance equal to twice the length of the mucro. Manubrium and dentes densely setaceous on all sides, without scales ventrally. Mucro (fig. 87) with subequal apical and anteapical teeth. Rami of tenaculum quadridentate; corpus with one strong seta, curving distally. Body scales (fig. 88) pale brown, mostly broadly lanceolate to ovate, apically pointed, with long coarsely spaced parallel striae. Length, up to 2.1 mm.

This description agrees essentially with that of the Javanese species, *Sira jacobsoni* Börner (1913*b*, p. 49). The Hawaiian specimens differ from the description by Handschin (1925*b*, p. 237) in not having a metanotal band and in having relatively longer unguiculi. His material came from Sunda Islands.

Honolulu, May 7, 1928, in pineapple soil (J. F. Illingworth); Oahu, November, 1928, in rice straw (R. H. Van Zwaluwenburg); Wahiawa, December 3, 1928, in pineapple soil (J. F. Illingworth).

Specimens.—Cat. No. 43769, U. S. N. M.

Genus Lepidocyrtus Bourlet

KEY TO SPECIES

1. Mesonotum projecting strongly over the head. Apical tooth of mucro very long and slender. A white species.....*heterophthalmus*, p. 68
   Mesonotum not strongly projecting. Apical tooth of mucro short..... 2
2. Iridescent purple or metallic gray.....*cyaneus*, p. 68
   White or pale yellowish..... 3
3. Body white throughout. Abd. 4 three to four times as long as abd. 3 .....*immaculatus*, p. 68
   White or pale yellow when denuded, usually faintly flecked with blue. Abd. 4 one-tenth to six-tenths longer than abd. 3.....*inornatus*, p. 68

Lepidocyrtus heterophthalmus Carpenter.

See Carpenter, 1904, p. 300.

Lepidocyrtus cyaneus Tullberg. (Plate 8, figs. 89-91).

The Hawaiian examples of this species agree with European and North American representatives of the species.

Iridescent purple. (Metallic gray in var. *cinereus* Fols.) Denuded of scales the body is purple, with white intersegmental bands. The bases of the legs are purple, but the femora and tibiotarsi are white. Length, 1.1 mm. See figures 89-91.

For full descriptions of this species refer to Folsom, 1919, p. 14, and 1924, p. 9.

L. cyaneus is a common species in most parts of Europe and North America and is known also from Mexico, Greenland, Siberia, Africa and Bismarck Archipelago.

Pupukea, Oahu, October 1, 1928, in pineapple soil (J. F. Illingworth).

Lepidocyrtus inornatus new species. (Plate 9, figs. 92, 93).

White or pale yellow when denuded of scales, and usually weakly and indefinitely flecked and mottled with blue on the head dorsally and laterally and on th. 2 to abd. 5, inclusive. In the largest individuals these segments are broadly banded with blue dorsally. Antennae bluish throughout. Legs and furcula unpigmented, or legs slightly pigmented basally. Eyes sixteen, subequal. Antennae a little longer than the head (as 1.3 : 1), with segments about as 7 : 12 : 13 : 26. Mesonotum projecting slightly over the occiput. Abd. 4 from one-tenth to six-tenths longer than abd. 3. Unguis (fig. 92) with two pairs of inner teeth and a pair of outer teeth. Unguiculus extending as far as the distal teeth of the unguis, oblong, acute, untoothed. Tenent hair as long as unguiculus, weakly knobbed. Dentes slightly longer than manubrium; both with scales ventrally and abundant fringed setae dorsally; non-annulated region of dens two-thirds longer than the mucro. Mucro (fig. 93) relatively elongate, with long basal spine. Rami of tenaculum quadridentate; corpus with one strong curving anterior seta. Length, 1.5 mm.

Honolulu, May 4, 7, 1928, in pineapple soil (J. F. Illingworth).

Lepidocyrtus immaculatus new species. (Plate 9, figs. 94-96).

White throughout, excepting the black eye spots and the median ocellus. Eyes (fig. 94) sixteen, unequal. Antennae from three-tenths to five-tenths longer than the head. Antennal ratios noted were 8 : 17 : 15 : 30; 6: 13 : 11 : 27; 6 : 15 : 14 : 31; third segment shorter than the second. Mesonotum not projecting far over the head. Abd. 4 from three to four times as long as abd. 3. Unguis (fig. 95) with two pairs of inner teeth and a pair of lateral teeth. Unguiculus extending three-fifths as far as the unguis, oblong-lanceolate, acute, untoothed. Tenent hair short, equal to unguiculus in length. Furcula with scales ventrally. Dens slightly longer than manu-

brium; dorsal non-annulated region one and one-half times as long as the mucro. Mucro (fig. 96) with long basal spine. Scales apically rounded. Length, 1.2 mm.

This species differs in only a few details from *L. rivularis* Bourl. var. *albicans* Reut., a common species in Europe (Stach, 1922, p. 32). It lacks the antennal coloration of *albicans*, however; ant. 3 is shorter than ant. 2; abd. 3 is relatively shorter than abd. 4; and the non-annulated region of the dens is much shorter than in *albicans*.

Honolulu, October 8, 1927, among pineapple roots (J. F. Illingworth); Oahu and Maui, in cane soil (R. H. Van Zwaluwenburg).

Cotypes.—Cat. No. 43770, U. S. N. M.

Genus Drepanocyrtus Handschin

Drepanocyrtus terrestris new species. (Plate 9, figs. 97-102; Plate 10, figs. 103, 104).

White when denuded of scales; with scales, brownish. Individuals up to about one millimeter in length are entirely white, excepting the eye spots and antennae. Large individuals (fig. 97) may have the mesonotum bordered anteriorly and laterally with purple, with a purple ventro-lateral patch on th. 3, abd. 1, 2 and 3. These patches may extend dorsally (fig. 98), and in the most heavily pigmented specimens may form dorsal bands. Abd. 4 may or may not be pigmented laterally. A purple spot marks the position of the frontal ocellus. Antennal base often ringed with purple; ant. 1 white, or purple apically; ant. 2 purple apically or throughout; ant. 3 white basally or purple throughout; ant. 4 entirely purple. Legs unpigmented except in the largest individuals, in which all the segments may be tinged with purple, with spots on coxae and precoxae. Furcula unpigmented. Eyes (fig. 99) sixteen, unequal, the two anterior eyes on each side being much larger than the others. Antennae two to two and one-half times as long as the head, or three-sevenths as long as the body, with segments about as 7 : 12 : 14 : 13 or 5 : 7 : 8 : 14; none of the segments annulated. Ant. 4 with a terminal tubercle. Mesonotum not projecting over the head. The body segments vary considerably in relative lengths; abd. 4 from 2.25 to 3.9 times as long as abd. 3. Unguis (fig. 100) with three pairs of inner teeth, a pair of small lateral teeth one-third from the base, and an outer tooth slightly more proximal than the last (fig. 101). Unguiculus extending two-thirds as far as the unguis, sublanceolate, acute, untoothed. Tenent hair a little longer than the inner margin of the unguis. All the tibiotarsi are subsegmented, the proximal subsegment being about twice as long as the distal on the first two pairs of legs, and about two and one-half times as long on the hind legs. Furcula attaining the ventral tube. Dentes about one-fifth longer than the manubrium, coarsely crenulate dorsally, the crenulations stopping abruptly; non-crenulated region twice as long as the mucro (fig. 102). Dentes with dorsal setae and ventral scales. Mucrones (figs. 102, 103)

falcate. Rami of tenaculum quadridentate; corpus with one strong anterior seta. Clavate setae occur dorsally in dense clusters on th. 2 and th. 3, and more sparsely on head and abdomen. Extra long, minutely fringed setae occur on the head, first two antennal segments, and the legs, being abundant on femora and tibiotarsi. Body scales (fig. 104) variable in size and form, but mostly broadly elliptical to oval, apically rounded, and closely covered with fine short striae. Length, 1.7 mm; maximum, 2.1 mm.

Several large individuals of this species, taken in the soil among pineapple roots, were entirely white, excepting the eye spots. Even the scales were white.

This species is close to *Pseudosira pseudocaerulea* Denis (1924*b*, p. 244; 1929*a*, p. 104) from Africa and Madagascar. I sent specimens of it to Dr. Denis, who reported that it differs from that species in lacking the basal tooth of the unguiculus, and in having longer inner teeth on the unguis and a different type of scale ornamentation.

He says, however, that this Hawaiian form is even closer to his Costa Rican *Lepidocyrtinus domesticus* (Nic.) *coloratus* (Denis, 1931, p. 142), from which it differs in lacking the teeth of the unguiculus which are characteristic of *domesticus*.

Besides this difference, the Hawaiian form appears to differ from typical *domesticus* of Europe in the relative sizes of the eyes, and in having relatively shorter antennae and fourth abdominal segment (see Denis, 1924*a*, p. 266).

As Dr. Denis says, we do not at present know the range of variation in these forms under consideration; therefore I am placing *terrestris* as a species rather than a variety—for the present, at least.

This species is reported to be very abundant on the surface of pineapple soils under mulching paper, and to feed largely upon decomposing plant refuse. It is common also in the soil, and occurs among pineapple roots. In cane fields the species is found not only in the soil but also on the growing plant, often under leaf sheaths of sugar cane.

Honolulu, March 7, April 5, October 8, 1927; May 4, 7, 9, October 1, 4, 1928 (J. F. Illingworth and R. H. Van Zwaluwenburg); September, 1930 (F. X. Williams); Wahiawa, Oahu, July 28, December 3, 1928 (J. F. Illingworth); Pupukea, Oahu, October 1, 1928 (J. F. Illingworth).

Cotypes.—Cat. No. 43771, U. S. N. M.

Tribe PARONELLINI Börner

Genus SALINA MacGillivray

Cremastocephalus Schött (1896, p. 175) is a synonym of *Salina* MacGillivray (1894, p. 107). See Folsom, 1927, p. 10.

Salina maculata new species. (Plate 10, figs. 105-110).

Salina maculata is yellow, marked with dark purple, almost black. In lateral aspect six large spots, on abd. 2 to 4, inclusive, as shown in figure 105, are constant. Mesonotum bordered with pigment anteriorly and laterally; metanotum and often the first three abdominal terga also bordered laterally. First three antennal segments ringed apically; fourth segment purplish distally. Femur with a distal spot; tibiotarsus with a spot near the base and another beyond the middle. Furcula unpigmented. Eyes (fig. 106) eight on each side, unequal, in two parallel rows, on a common black spot. Antennae from one-fifth to four-fifths longer than the head and body, with segments variable in relative lengths, but averaging 11 : 18 : 14 : 15. Ant. 4 annulate; ant. 2 and 3 obscurely annulate. Mesonotum to fourth abdominal tergite in relative lengths as 14 : 6 : 4 : 8 : 1 : 34. Third abdominal tergite greatly reduced dorsally. Unguis (fig. 107) with two pairs of inner teeth, the distal pair weak. Unguiculus extending three-fourths as far as the unguis, with an inner angle tooth. Tenent hair strong, much longer than the unguis. Furcula almost as long as the body. Dentes longer than manubrium, often one-fifth longer. Mucro trilobed apically, as in figures 108-110. The dorsal apical bladderlike organ of the dens is somewhat obovate in lateral aspect, with usually an apical lobe, and is two-thirds as long as the mucro. Length, 1.9 mm.

This species is closely related to the Indian species *montanus* Imms (1912, p. 105) but differs from the latter in the form of the appendage of the dens, the length of the third abdominal tergite, and the presence of a tooth on the unguiculus. The color pattern of *montanus* was not described; possibly it is indefinite.

Oahu, in soil in cane fields and under leaf sheaths of sugar cane (R. H. Van Zwaluwenburg); Kauai, soil in cane fields (R. H. Van Zwaluwenburg); Kona, Hawaii, March 12, 1928, from coffee leaves (J. F. Illingworth).

Cotypes.—Cat. No. 43772, U. S. N. M.

Tribe CYPHODERINI Börner

Genus CYPHODERUS Nicolet

Cyphoderus assimilis Börner. (Plate 10, figs. 111-112).

White. Eyes absent. Antennae from one-fifth to three-fifths longer than the head, with segments about as 9 : 23 : 14 : 35, or 8 : 19 : 11 : 28.

Abd. 4 about two and one-half times as long as abd. 3. Unguis (fig. 111) almost straight, quadridentate. Of the basal wing-teeth of the unguis, the anterior is narrowly suboblong; the posterior much longer and narrowly triangular. Beyond are two strong teeth. The apex of the claw projects from a membranous tunica. Unguiculus extending three-fourths as far as the unguis, with a large acute outer lobe. Tenent hair as long as the inner border of the unguis. Dens two-thirds as long as manubrium; outer dorsal pinnae 5 to 7, all short; inner dorsal pinnae 5, there being 4 short proximal pinnae and 1 long distal pinna, which extends to the anteapical tooth of the mucro (fig. 112); the outer distal pinna is five-ninths as long as the mucro. Ventroapical scale of dens extending beyond the mucro. Mucro (fig. 112) almost half as long as dens, bidentate, with a narrow lamella extending forward from the anteapical tooth.

This form agrees essentially with the description of *C. assimilis* Börner (1906, p. 181), although the ventro-apical scale under the mucro is longer than in his description, and the posterior wing-tooth of the unguis broader than in his figure (Börner, 1913, p. 277). As in the species referred to *assimilis* by Handschin (1926, p. 460), the unguis has a peculiar apical membrane.

C. assimilis was described from specimens in Germany on orchids from the West Indies. Handschin studied material from Java. I now regard my *C. similis* (Folsom, 1927, p. 12) from Panama as synonymous with *assimilis* Börner.

Honolulu, February, 1930, with *Pheidole* ants (F. X. Williams).

Specimens.—Cat. No. 43773, U. S. N. M.

Subfamily SMINTHURIDINAE Börner

Abd. 5 and 6 ankylosed, broadly joined to abd. 4. Males with clasping antennae ..... SMINTHURIDES

Genus SMINTHURIDES Börner

Sminthurides ramosus new species. (Plate 10, fig. 113; Plate 11, figs. 114-123; Plate 12, figs. 124-126).

FEMALE. Head and body mostly purple. Sternum unpigmented. Antennae dull purple to clear purple throughout. Legs pale, tinged with purple. Manubrium slightly pigmented; dentes unpigmented. Eyes at least twelve (fig. 113), possibly sixteen, on black spots. Antennae subequal to head in length, elbowed between ant. 1 and ant. 2, with segments about as 10 : 16 : 15 : 27 (fig. 114). Ant. 3 organ with a pair of suboval or subreniform lobes as in figures 115 and 116. Ant. 4 not subsegmented. Thoracic segmentation absent dorsally. Genital and anal segments ankylosed

into a single mass. Unguis (fig. 117) slender, with a long inner tooth a little beyond the middle, and a pair of small lateral teeth; the inner tooth is often weak on the hind feet. Unguiculus half as long as the inner margin of the unguis, slender, tapering, with a subapical filament longer than the unguiculus and exceeding the unguis. This filament is distinctly knobbed in some cases, and not in others. Knobbed tenent hairs absent. Tibiotarsal organ of hind legs absent. Vesicles of ventral tube smooth-walled. Dentes with strong curving simple setae dorsally and laterally; ventrally with many short, stiff, appressed setae except basally. Mucro (fig. 118) with outer margin entire, inner margin serrate, and with a baso-lateral seta. Rami of tenaculum tridentate (fig. 119); anterior lobe of corpus with two setae (sometimes three). Head and body with strong stiff spinelike setae (fig. 120). The suranal lobe of the female bears on each side a strong branched seta (fig. 120); a similar seta also occurs dorsally on each subanal lobe. In manner of branching these setae vary considerably (figs. 121, 122). Filiform bothriotricha are present. On each side of the body mass, three antero-dorsal were seen; and on each side, near the base of the ano-genital segment, two dorso-lateral. Integument minutely tuberculate. Length, 1 mm.

MALE. Body and antennae purple. Legs tinged with purple. Furcula unpigmented. Antennae (fig. 123) remarkably stout, one-third longer than the head, with segments as 10 : 9 : 4 : 8. Ant. 2 and 3 are modified to form a complex gripping apparatus of various hooks and lobes (fig. 124). (The antennae of the male grasp those of the female at copulation.) Ant. 4 elliptical, not subsegmented. Each tibiotarsus of the front legs bears basally on the outer side four sense organs (fig. 125), externally elongate, suboblong, thick-walled and slightly elevated. Claws and mucrones similar to those of the female, though the latter (fig. 126) are more slender than in the female. Length, 0.6 mm.

Honolulu, November, December, 1925, in soil of cane fields (R. H. Van Zwaluwenburg).

Cotypes.—Cat. No. 43774, U. S. N. M.

Subfamily SMINTHURINAE Börner

Tibiotarsi with two or three short stout appressed tenent hairs. Anal segment of male with a clasping organ of curving setae.....BOURLETIELLA

Genus BOURLETIELLA Banks

Bourletiella insula new species. (Plate 12, figs. 127-132).

FEMALE. Body dorsally purple with numerous pale spots; posterolaterally with an area of small rounded pale spots; sternum mostly pale. Head purple dorsally; pale orally, and sometimes laterally. Antennae purple throughout. Legs pale, tinged faintly with purple, or pale throughout. Furcula unpigmented, or manubrium with a trace of purple apically. Eyes (fig. 127) sixteen. Antennae a little longer than the head (as 8 : 7), with

segments about as 4 : 8 : 11 : 18. Ant. 4 obscurely annulated, with apparently seven subsegments (fig. 128). Ant. 3 organ (fig. 129) with a pair of contiguous ovate lobes and two guard setae. Anal appendages of female as in figure 130. Unguis (fig. 131) slender, with one inner tooth one-third from the apex (tooth sometimes absent, especially on mid and hind feet). Unguiculus narrowly lanceolate, acuminate, extending from two-thirds to three-fourths (on hind feet) as far as the opposite unguis. Knobbed tenent hairs 3, 3, 3, appressed. Vesicles of ventral tube long, cylindrical, tuberculate. Manubrium and dentes with a few simple dorsal setae; dentes with a few lateral setae also; both naked ventrally. Dens seven-eighths as long as manubrium. Mucro (fig. 132) one-third as long as dens, with both dorsal margins entire. Rami of tenaculum tridentate; ventral lobe elongate, subcylindrical, rounded apically, with four short setae apically. General clothing of short simple curving setae. Length, 1.3 mm.

MALE. Head and body pale yellowish (normally white?), with less purple pigment than in the female. The abdominal postero-lateral area of small rounded spots is extensive. Genital and anal segments purple dorsally, otherwise pale. Antennal segments about as 7 : 12 : 22 : 38. Ant. 1 and 2 pale, purple apically; ant. 3 and 4 purple throughout. Legs and furcula unpigmented. Anal segment with dorsal hooked setae modified for clasping. Length, 0.8 mm.

Honolulu, April 23, November, 1925, in cane soil (R. H. Van Zwaluwenburg).

Cotypes.—Cat. No. 43775, U. S. N. M.

Subfamily DICYRTOMINAE Börner

Ant. 3 and 4, or only ant. 3, subsegmented. Dentes with serrate setae ..... PTENOTHRIX

Genus PTENOTHRIX Börner

Ptenothrix dubia new species. (Plate 12, figs. 133-136).

Variegated with olive, brown, purple and white. Body mostly brown dorsally, spotted with pure white (figs. 133, 134). On the anterior half of the dorsum (fig. 134) there is a median lanceolate translucent pale area bordered on each side with a row of chocolate-brown spots, which in turn are bordered laterally with irregular white spots. Head mostly blackish purple. Vertex with elliptical white spots between the eyes. Antennae (fig. 133) blackish with four white bands, as follows: on ant. 2, basally and apically; on ant. 3 subapically; and on ant. 4 basally. Legs (fig. 133) mostly purple beyond coxae; tibiotarsi white on distal three-fifths and sometimes at base; femora with an outer white streak. Ventral tube blackish purple. Manubrium and dentes purple throughout. Eyes sixteen. Antennal segments in relative lengths about as 5 : 21 : 24 : 7. Ant. 3 annulate on distal half, ant. 4 annulate throughout. Posterior part of abdomen with a large median-dorsal rounded tubercle (fig. 133), bearing numerous short stiff setae. Unguis (fig. 135) long and slender, with two strong inner teeth

and two pairs of small lateral teeth. Unguiculus extending half as far as the unguis, sublanceolate, with subapical filament exceeding the unguis, and with long slender inner tooth. Knobbed tenent hairs absent. Vesicles of ventral tube cylindrical, tuberculate. Manubrium naked ventrally. Dentes naked ventrally except distally; dorsally with numerous long stiff setae, the last three to five of which are basally serrate (fig. 136). Mucro (fig. 136) with both dorsal margins serrate. Clothing of short simple setae. Integument granulate. Length, 2.3 mm.

This species, with its characteristic dorsal tubercle, may be *Ptenothrix mirabilis* Denis (1929*b*, p. 319), described from China. Additional material from China is desirable, as that studied by Dr. Denis was in too poor condition to show the color pattern.

Two of Denis' specimens had the dorsal tubercle and two did not have it; though all four seemed to be the same species. Denis suggests, therefore, that the species is sexually dimorphic, and that the individuals with the tubercles are the females.

The material of *P. dubia* consists of four individuals, all of which have the dorsal tubercle.

Hering Valley, Tantalus, Honolulu, December 31, 1929, on damp boulder (F. X. Williams).

Cotypes.—Cat. No. 43776, U. S. N. M.

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Explanation of Plates

Plate 1

Schöttella alba

Fig. 1. Eyes and postantennal organ of right side. Fig. 2. End of right antenna, dorsal aspect. Fig. 3. Right hind foot. Fig. 4. Right dens and mucro.

Xenylla sensilis

Fig. 5. Eyes of left side. Fig. 6. Sense organ of third antennal segment of right side. Fig. 7. Apex of right antenna, dorsal aspect. Fig. 8. Right fore foot. Fig. 9. Concave aspect of unguis. Fig. 10. Anal spines. Fig. 11. Left dens and mucro. Fig. 12. Right mucro. Fig. 13. Dorsal setae of metanotum.

Plate 2

Xenylla alba

Fig. 14. Eyes of right side. Fig. 15. Sense organ of third antennal segment of right side. Fig. 16. Apex of right antenna, dorsal aspect. Fig. 17. Right hind foot. Fig. 18. Anal spine. Fig. 19. Left dens and mucro. Fig. 20. Right dens and mucro.

Stachia minuta

Fig. 21. Lateral aspect. Fig. 22. Left eye and base of antenna. Fig. 23. Left eye and postantennal organ. Fig. 24. Mandible. Fig. 25. Maxilla. Fig. 26. Dorsal aspect of anal segment.

Plate 3

Stachia minuta

Fig. 27. Suranal and subanal valves. Fig. 28. Extremity of left fore foot. Fig. 29. Furcula, dorsal aspect. Fig. 30. Furcula, left aspect.

Protanura capitata

Fig. 31. Dorsal aspect. Fig. 32. Sense organ of third antennal segment of right side. Fig. 33. Extremity of right antenna, dorsal aspect. Fig. 34. Head of right mandible. Fig. 35. Head of right maxilla. Fig. 36. Left hind foot.

Plate 4

Tullbergia silvicola

Fig. 37. Dorsal aspect. Fig. 38. Left postantennal organ with pseudocellus. Fig. 39. Sense organ of third antennal segment of right side. Fig. 40. Left hind foot. Fig. 41. Left anal spine.

Folsomides exiguus

Fig. 42. Lateral aspect. Fig. 43. Eyes and postantennal organ of left side. Fig. 44. Mandible. Fig. 45. Left hind foot. Fig. 46. Right fore foot. Fig. 47. Left aspect of manubrium and mucrodens.

PLATE 5

Isotomodes denisi

Fig. 48. Lateral aspect. Fig. 49. Left postantennal organ. Fig. 50. Sense organ of third antennal segment of left side, in optical cross section. Fig. 51. Same, surface aspect. Fig. 52. Ventral aspect of extremity of left antenna. Fig. 53. Head of mandible. Fig. 54. Head of maxilla. Fig. 55. Left hind foot. Fig. 56. Left dens and mucro.

Denisia falcata

Fig. 57. Lateral aspect.

PLATE 6

Denisia falcata

Fig. 58. Lateral aspect of extremity of left antenna. Fig. 59. Left hind foot. Fig. 60. Right mucro and part of dens. Fig. 61. Left mucro. Fig. 62. Clothing of abd. 2.

Proisotoma nigromaculosa

Fig. 63. Eyes, postantennal organ and base of antenna of left side. Fig. 64. Right hind foot. Fig. 65. Left mucro. Fig. 66. Left mucro.

Isotoma minor

Fig. 67. Extremity of left antenna. Fig. 68. Extremity of left antenna. Fig. 69. Left hind foot. Fig. 70. Left mucro. Fig. 71. Dorsal setae, abd. 2.

PLATE 7

Entomobrya multifasciata imminuta

Fig. 72. Lateral aspect. Fig. 73. Eyes of left side. Fig. 74. Right hind foot. Fig. 75. Left mucro and end of dens.

Entomobrya lactea

Fig. 76. Eyes of left side. Fig. 77. Left hind foot. Fig. 78. Left mucro and end of dens.

Sinella höfti

Fig. 79. Right hind foot. Fig. 80. Subclavate seta of hind tibiotarsus. Fig. 81. Left mucro and end of dens.

Plate 8

Sira jacobsoni

Fig. 82. Dorsal aspect. Fig. 83. Dorsal aspect. Fig. 84. Eyes of left side. Fig. 85. Right mid foot. Fig. 86: Right mid foot. Fig 87. Left mucro and end of dens. Fig. 88. Body scale.

Lepidocyrtus cyaneus

Fig. 89. Left aspect of mesonotum. Fig. 90. Right hind foot. Fig. 91. Left mucro and end of dens.

Plate 9

Lepidocyrtus inornatus

Fig. 92. Left hind foot. Fig. 93. Left mucro and end of dens.

Lepidocyrtus immaculatus

Fig. 94. Eyes of right side. Fig. 95. Right hind foot. Fig. 96. Right mucro and end of dens.

Drepanocyrtus terrestris

Fig. 97. Lateral aspect. Fig. 98. Lateral aspect. Fig. 99. Eyes of right side. Fig. 100. Left hind foot. Fig. 101. Unguis. Fig. 102. Mucro and end of dens.

Plate 10

Drepanocyrtus terrestris

Fig. 103. Left mucro and end of dens. Fig. 104. Typical body scale.

Salina maculata

Fig. 105. Lateral aspect. Fig. 106. Eyes of right side. Fig. 107. Left mid foot. Fig. 108. Right mucro. Fig. 109. Left mucro. Fig. 110. Right mucro.

Cyphoderus assimilis

Fig. 111. Left hind foot. Fig. 112. Left mucro.

Sminthurides ramosus

Fig. 113. Eyes of left side.

Plate 11

Sminthurides ramosus

Fig. 114. Left antenna of female. Fig. 115. Sense organ of third antennal segment of left side, female. Fig. 116. Same as No. 115. Fig.

117. Right fore foot of female. Fig. 118. Left mucro of female. Fig. 119. Left aspect of tenaculum, female. Fig. 120. Left aspect of suranal and left subanal lobes of female. Fig. 121. Branched seta of left subanal lobe of female. Fig. 122. Same as No. 121. Fig. 123. Left antenna of male.

Plate 12

Sminthurides ramosus

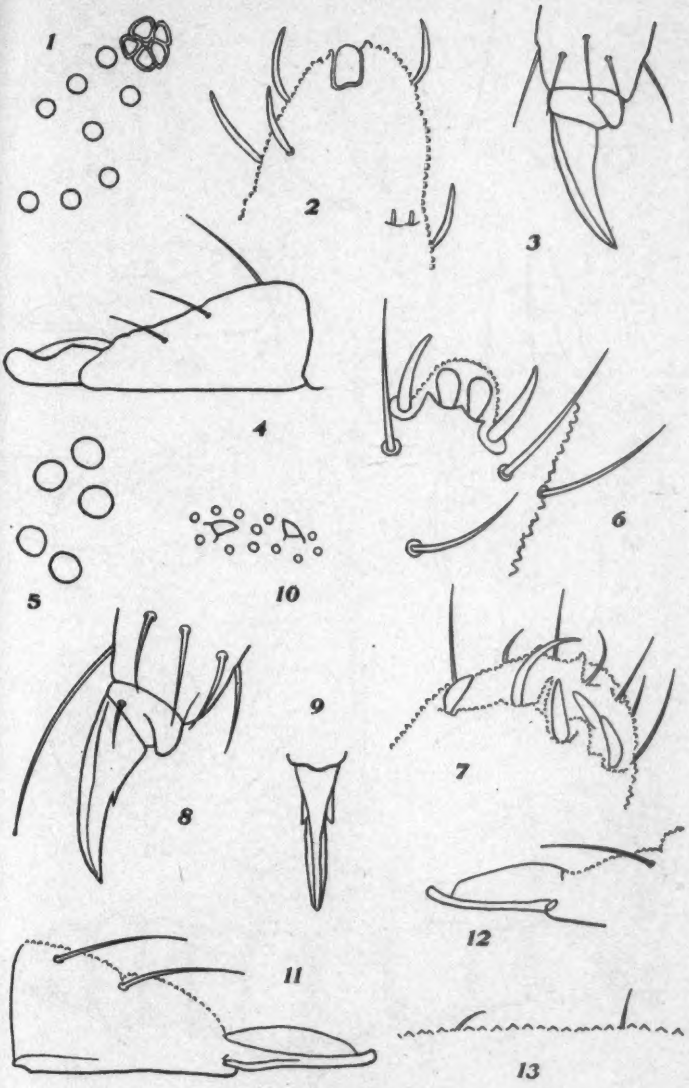
Fig. 124. Second and third segments of left antenna of male. Fig. 125. Base of front tibiotarsus of male. Fig. 126. Left mucro of male.

Bourletiella insula

Fig. 127. Eyes of left side. Fig. 128. Fourth antennal segment of female. Fig. 129. Sense organ of third antennal segment of left side. Fig. 130. Left subanal appendage of female, lateral aspect. Fig. 131. Left fore foot. Fig. 132. Left mucro.

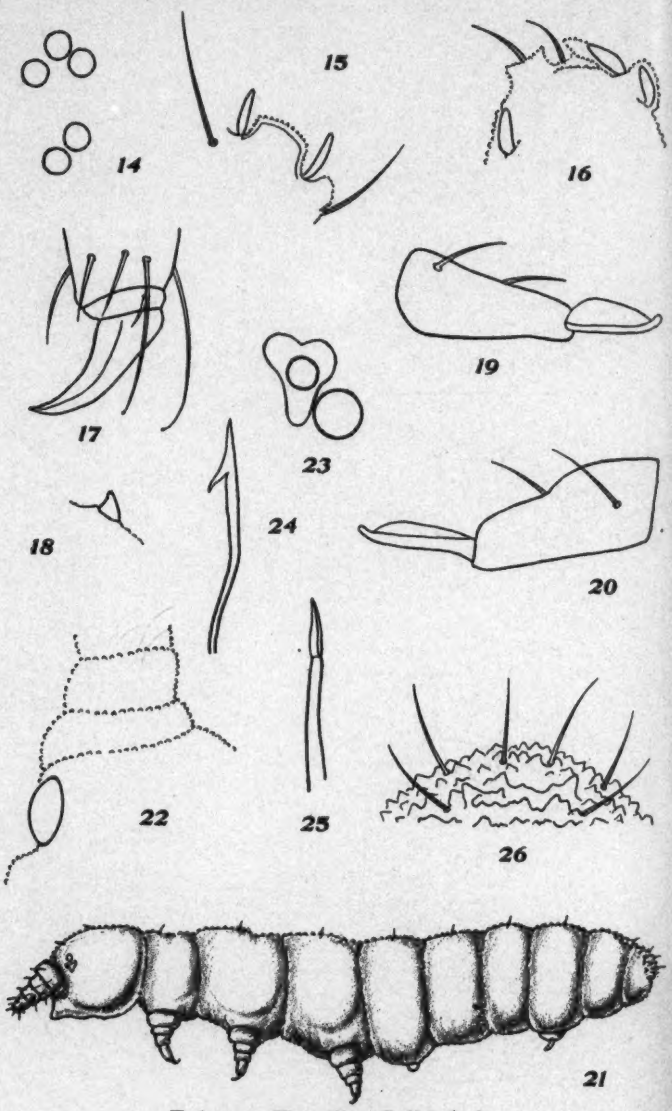
Ptenothrix dubia

Fig. 133. Lateral aspect. Fig. 134. Dorsal aspect of body. Fig. 135. Left hind foot. Fig. 136. Left mucro.



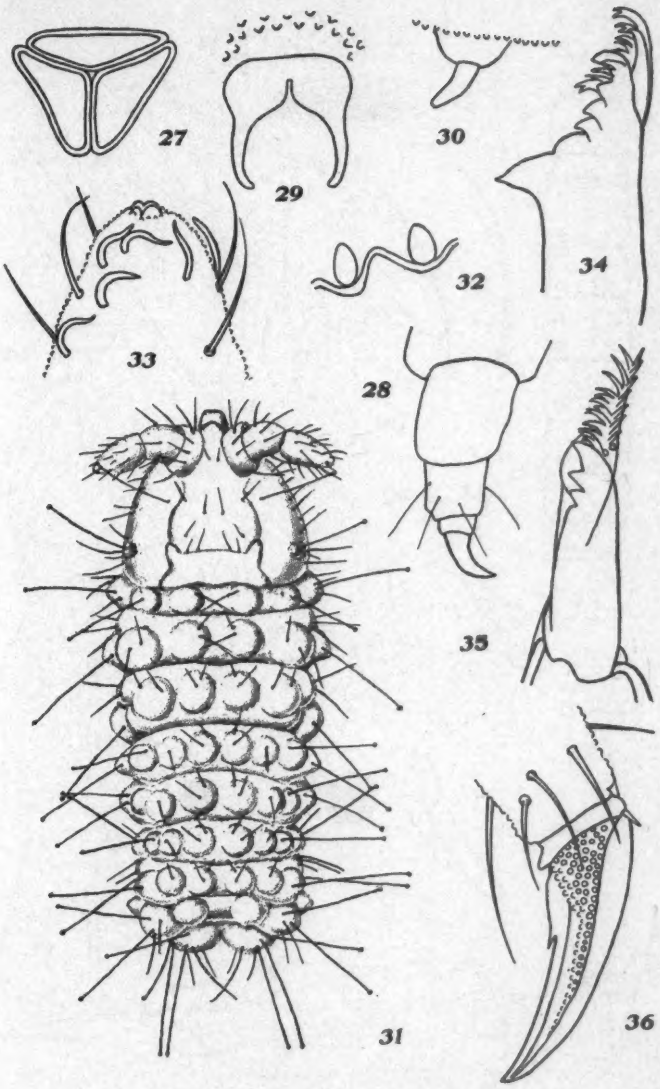
Folsom. Hawaiian Collembola

1-4. *Schöttella alba*
5-13. *Xenylla sensilis*



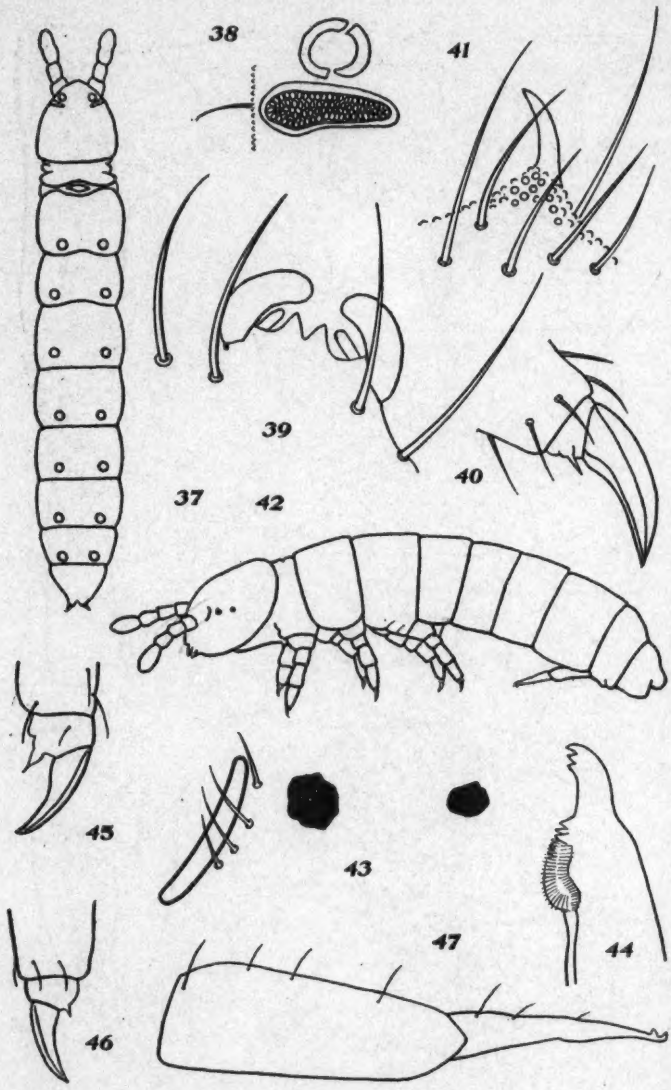
Folsom. Hawaiian Collembola

14-20. *Xenylla alba*
21-26. *Stachia minuta*



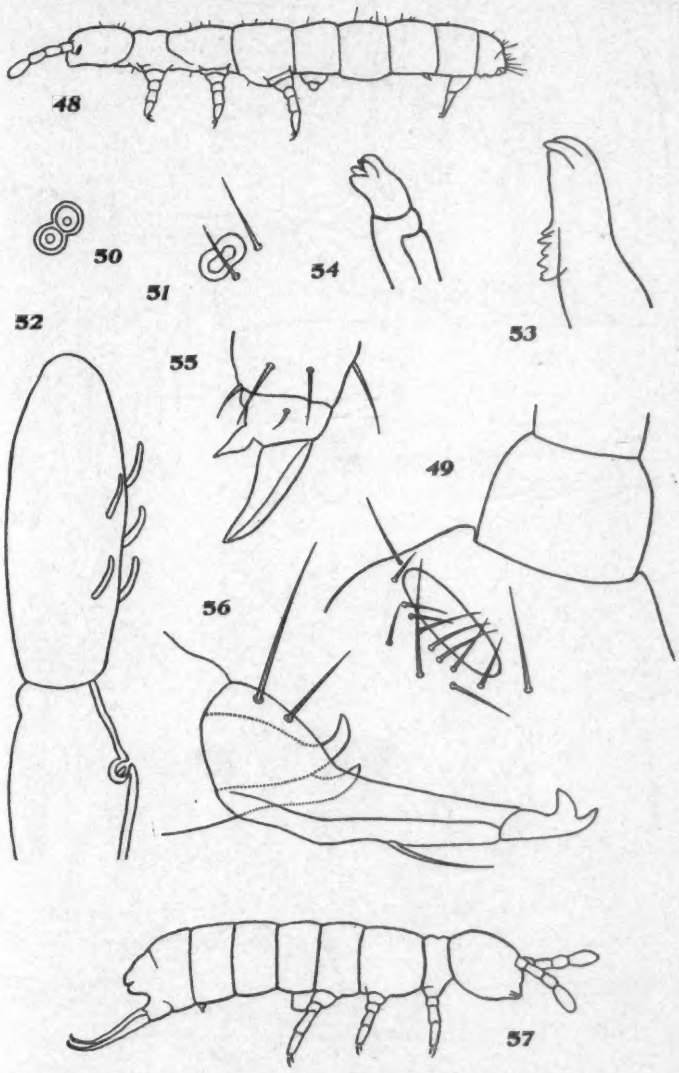
Folsom. Hawaiian Collembola

27-30. *Stachia minuta*
31-36. *Protanura capitata*



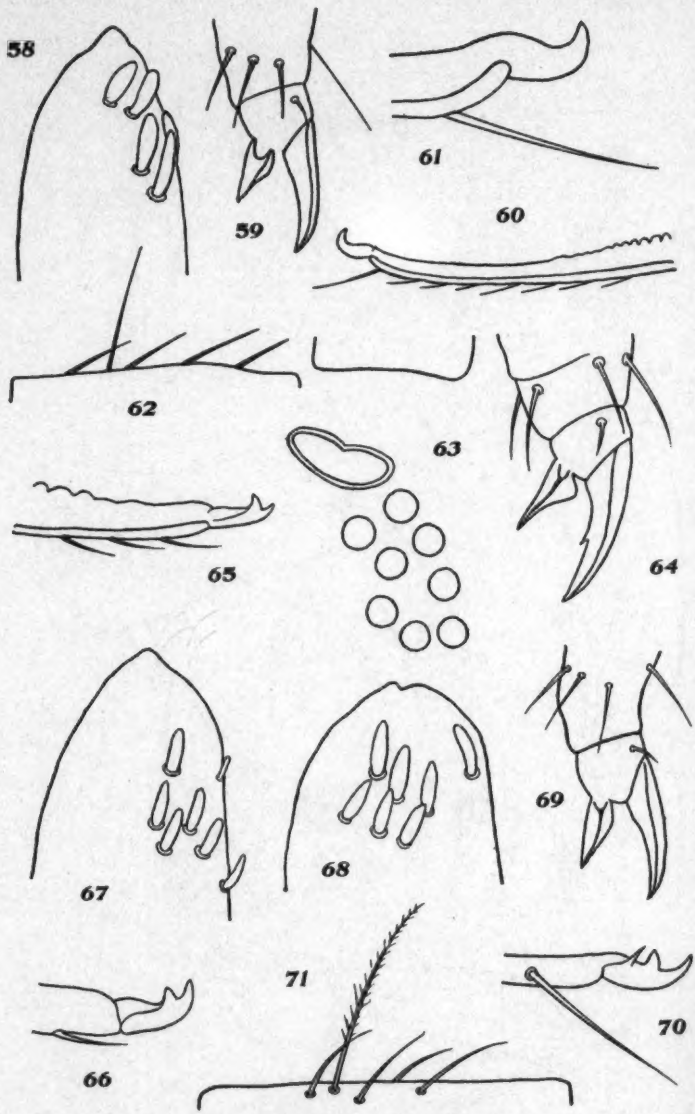
Folsom. Hawaiian Collembola

37-41. *Tullbergia silvicola*
42-47. *Folsomides exiguus*



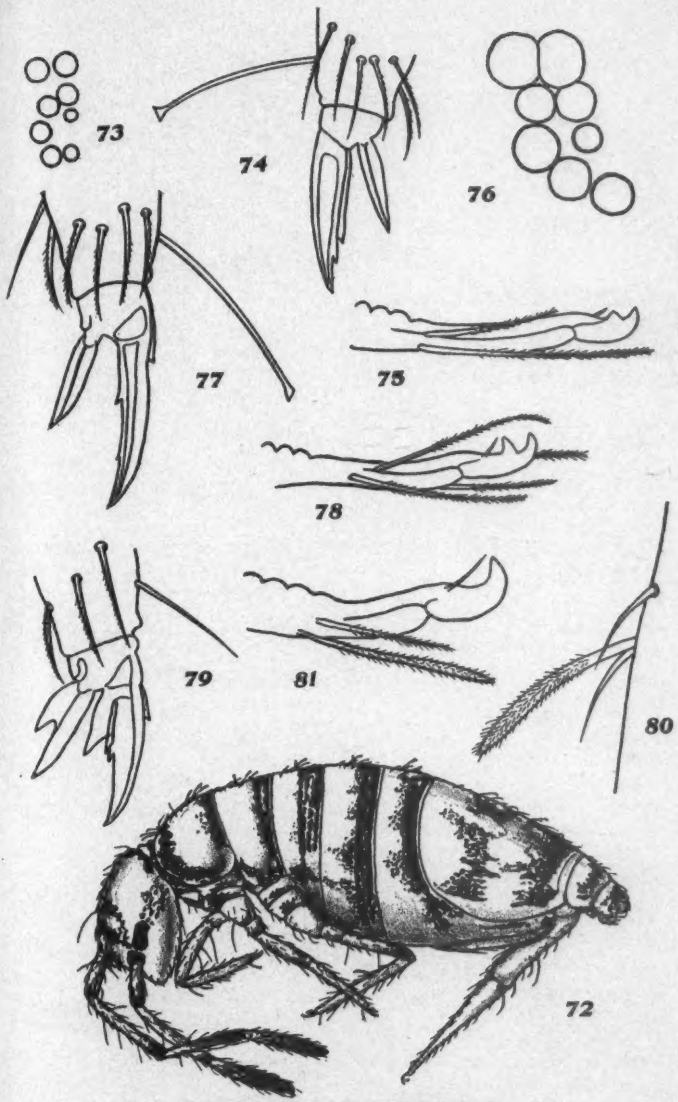
Folsom. Hawaiian Collembola

48-56. *Isotomodes denisi*
57. *Denisia falcata*



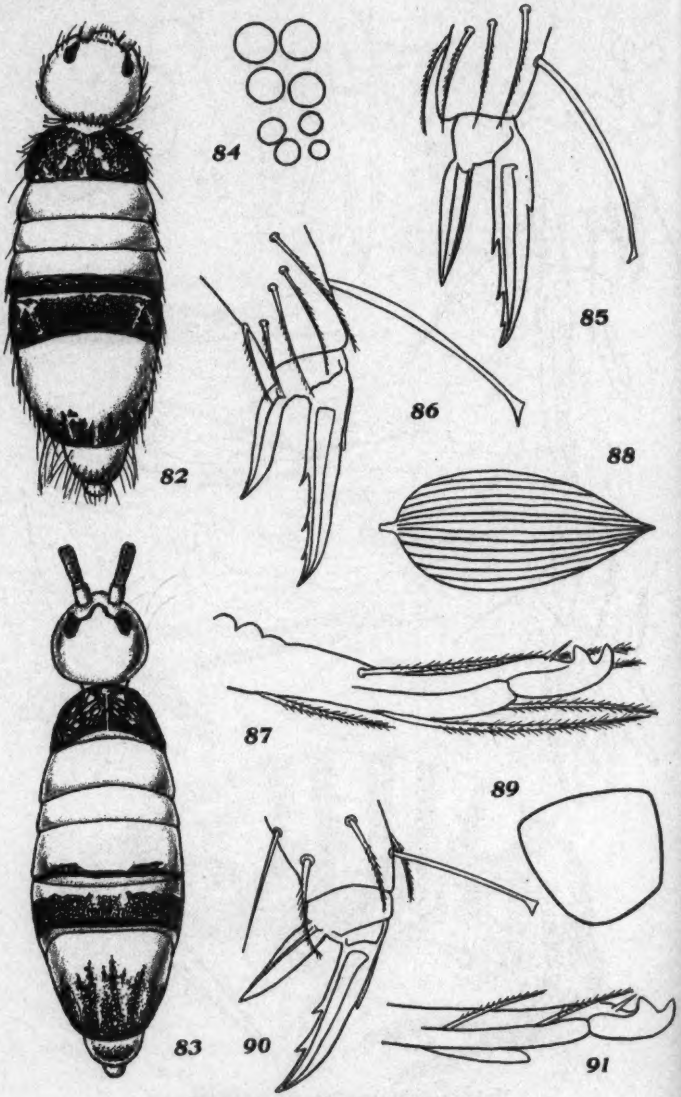
Folsom. Hawaiian Collembola

58-62. *Denisia falcata*
63-66. *Proisotoma nigromaculosa*
67-71. *Isotoma minor*



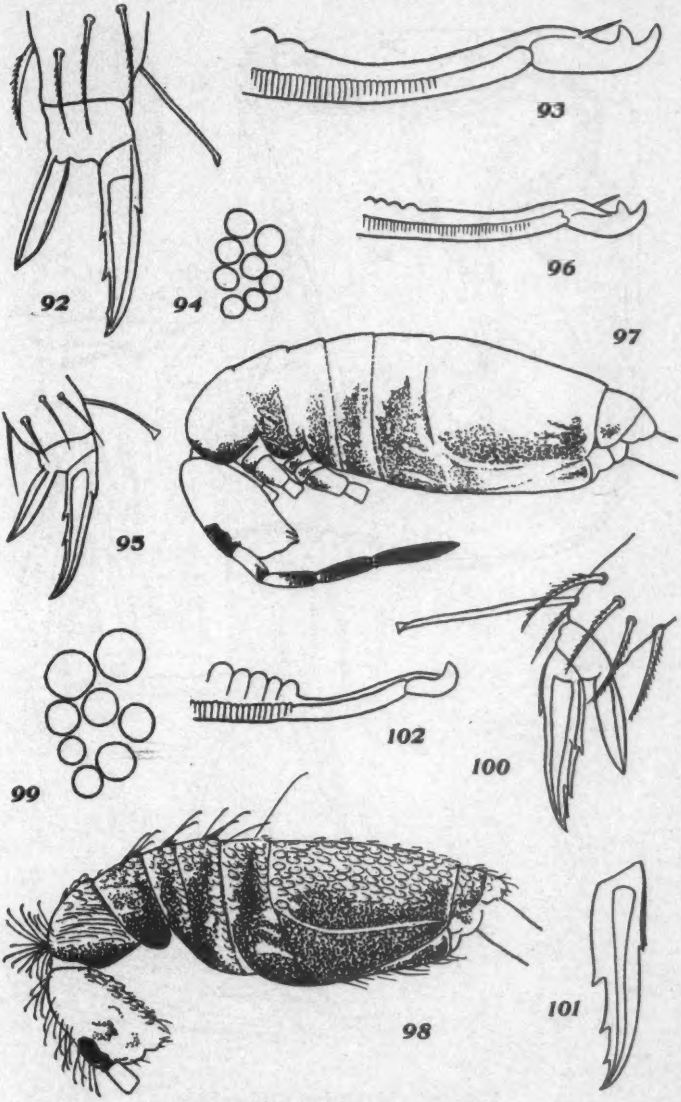
Folsom. Hawaiian Collembola

72-75. *Entomobrya multifasciata imminuta*
76-78. *Entomobrya lactea*
79-81. *Sinella höfti*



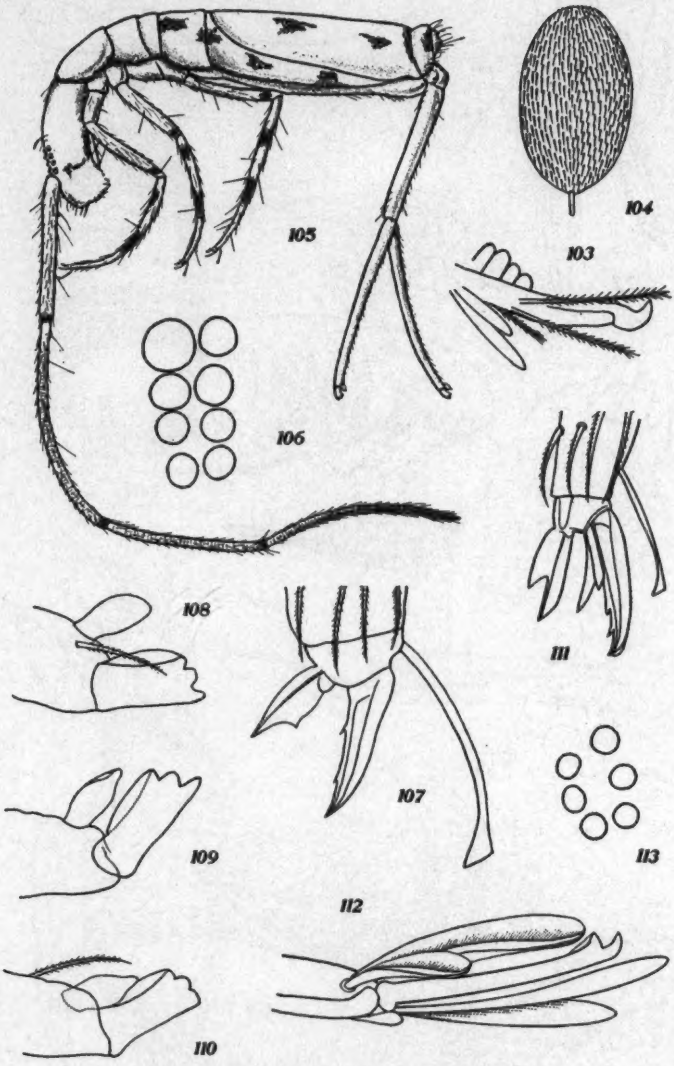
Folsom. Hawaiian Collembola

82-88. *Sira jacobsoni*
89-91. *Lepidocyrtus cyaneus*



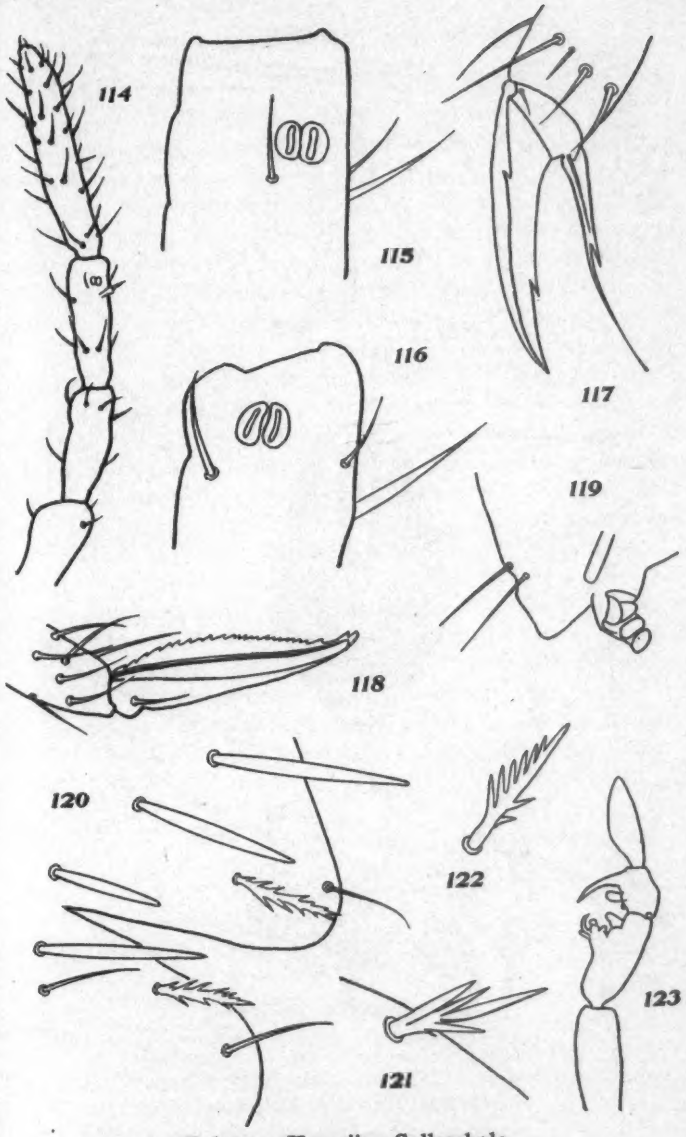
Folsom. Hawaiian Collembola

92-93. *Lepidocyrtus inornatus*
94-96. *Drepanocyrtus immaculatus*
97-102. *Drepanocyrtus terrestris*



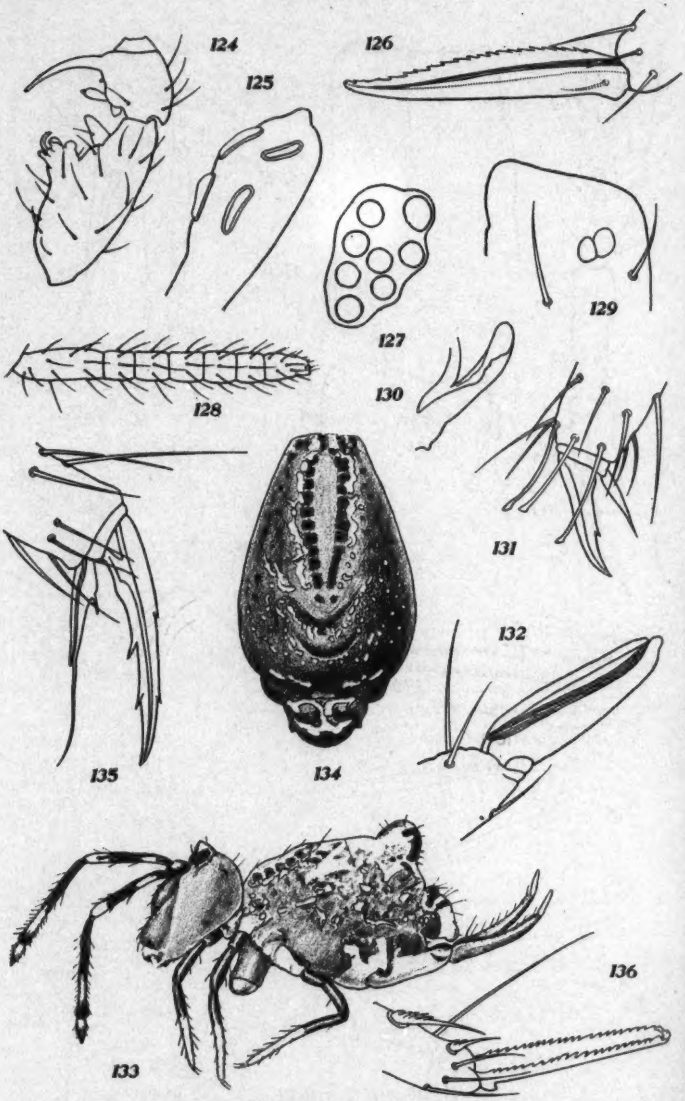
Folsom. Hawaiian Collembola

103-104. *Drepanocyrtus terrestris*
105-110. *Salina maculata*
111-112. *Cyphoderus assimilis*
113. *Sminthurides ramosus*



Folsom. Hawaiian Collembola

114-123. *Sminthurides ramosus*



Folsom. Hawaiian Collembola

124-126. *Sminthurides ramosus*
127-132. *Bourletiella insula*
133-136. *Ptenothrix dubia*

Synopsis of the Hawaiian Diaspinae (Coccidae)

BY D. T. FULLAWAY

(Presented at the meeting of April 2, 1931)

The Coccidae, on account of their economic importance, have received a large share of attention in Hawaii, but owing to the confusion which prevailed for years in the specific identification and grouping of these insects (growing out of the attempt to elucidate this large group hurriedly through work in different and widely separated countries), the earliest records of these insects here present quite a few inaccuracies in regard to species determination and are not even to be relied on as valid representations in a few cases, since some of the examples on which the records are based were evidently taken from newly imported horticultural plants. For instance, the following species listed by Kirkaldy in Fauna Hawaiiensis, Hemiptera, are not generally recognized here now, viz.: *Aspidiotus persearum, A. perniciosus, A. transparens* (*lataniae*?), *greeni, duplex* (*P. clavigera*?), *Diaspis patelliformis* (*S. pentagona*?), *Lepidosaphes pinnaeformis* (*L. beckii*?), *L. pomorum, Howardia prunicola* and *Fiorinia pellucida* (*F. fioriniae*?); nor are *Chionaspis citri* and *Aspidiotus destructor* of Kotinsky's list. On the other hand there are a few well-recognized species here that are not placed in either of these lists and one or two possibly that have never been recorded here. To the best of my knowledge the following species represent the present diaspine fauna (numerals refer to table of literature consulted, following):

Parlatoriini

Parlatoria proteus var. *crotonis* (15, 25, 32)
" *mytilaspiformis* (8)
" *zizyphus* (2, 32)

Leucaspidini

(none)

Lepidosaphini

Lepidosaphes gloveri (8, 25, 26, 32)
" *auriculata* (22, 24)
" *beckii* (8, 25, 26, 32)
" *pallida* (8, 32)
Ischnaspis longirostris (3, 32)
Lepidaspidis uniloba (27, 32)
Andaspis flava var. *hawaiiensis* (7, 30)

Diaspidini

Aulacaspis rosae (25, 32)
" *fulleri* (10, 32)
" *major* (23, 29, 31)
Diaspis boisduvali (25, 32)
" *bromeliae* (32)
" *echinocacti* (32)
Phenacaspis eugeniae var. *sandwicensis*
Pinnaspis (*Hemichionaspis*) *buxi* (15)
" *minor* (32)
" *aspidistrae* (8, 25, 32)
Howardia biclavis (8, 32)
Tsukushiaspis pseudoleucaspis (16, 32)

Fioriniini

Fiorinia fioriniae (8, 12, 32)
" *nephelii* (13, 24)

Aspidiotini

Aspidiotus lataniae (8, 11, 25)
" *rapax* (8, 25)
" *hederae* (8, 25)
" *cyanophylli* (8, 9, 25)
Chrysomphalus aonidum (9, 25)
" *dictyospermi* (4, 9, 25)
" *rossi* (8, 9)
" *aurantii* (8, 9, 25)
Odonaspis secreta (8)
" *ruthae* (21, 33)
Morganella maskelli (4)
Pseudaonidia clavigera (9)

I give below a tentative list of host-plants. This could no doubt be considerably amplified with a little intensive work on this group.

Andaspis flava var. *hawaiiensis*—bark of shade trees.
Aspidiotus cydoniae—guava, Cycas, klu
" *rapax*—citrus
" *hederae*—Platydesma
" *cyanophylli*—sugar cane, mango, wistaria, avocado, Eugenia
Aulacaspis rosae—rose
" *fulleri*—Aglaia
" *major*—litchi, longan
Chrysomphalus aonidum—Cycas, citrus, coconut
" *dictyospermi*—palms, ferns, Verschaffeltia
" *rossi*—Araucaria
" *aurantii*—Cycas, citrus
Diaspis boisduvali—orchids
" *bromeliae*—pineapple
" *echinocacti*—Cereus
Fiorinia fioriniae—avocado
" *nephelii*—litchi

Howardia biclavis—papaya, Plumeria, Nephelium, hibiscus, Ficus, Cassia
Ischnaspis longirostris—palm
Lepidaspidis uniloba—maile
Lepidosaphes gloveri—citrus, croton
" *auriculata*—croton
" *beckii*—citrus, coconut
" *pallida*—juniper
Morganella maskelli—fig
Odonaspis secreta—bamboo
" *ruthae*—manienie
Parlatoria proteus var. *crotonis*—croton
" *mytilaspiformis*—orchids, croton
" *zizyphus*—citrus
Phenacaspis eugeniae var. *sandwicensis*—oleander, mango, coconut, kukui
Pinnaspis (*Hemichionaspis*) *buxi*—Philodendron, lauhala
" *minor*—hibiscus, avocado, geranium, yams, ferns
" *aspidistrae*—ferns
Pseudaonidia clavigera—grape, loquat, tamarind pods
Tsukushiaspis pseudoleucaspis—bamboo

Field Key to Species

1. Diaspines that are specific in their host relationship..... 2
   Diaspines that are not specific in their host relationship.....10
2. Female scale short oval to rectangular in outline (on croton).....
   .....*Parlatoria proteus* var. *crotonis*
   Not so 3
3. Female scale longitudinal, i.e., elongate, sometimes narrow in front, more or less broadened behind..... 4
   Female scale circular..... 6
4. Female scale six times as long as wide (on bamboo).....
   .....*Tsukushiaspis pseudoleucaspis*
   Female scale not more than three times as long as wide..... 5
5. Female scale with only one exuvia at anterior end; orange yellow, exuvia dark brown (on litchi).....*Fiorinia nephelii*
   Female scale with two exuviae at anterior end, entirely white, semi-diaphanous, exuviae pale stramineous (on croton).....
   .....*Lepidosaphes auriculata*
6. Female scale with exuviae in center..... 7
   Female scale with exuviae marginal..... 9
7. Female scale dark colored (reddish brown), exuviae blackish (on Araucaria) .....*Chrysomphalus rossi*
   Female scale light colored (chalky white), exuviae straw yellow..... 8
8. Bamboo-inhabiting species.....*Odonaspis secreta*
   Bermuda-grass-inhabiting species.....*Odonaspis ruthae*
9. Rose-inhabiting species.....*Aulacaspis rosae*
   Litchi and longan-inhabiting species.....*Aulacaspis major*
   Aglaia-inhabiting species.....*Aulacaspis fulleri*
   Cactus-inhabiting species.....*Diaspis echinocacti*
   Pineapple-inhabiting species.....*Diaspis bromeliae*
   Orchid-inhabiting species.....*Diaspis boisduvali*

10. Scales found principally on or under bark.....11
Scales found principally on leaf or stem.....13

11. Female scale light colored (under bark), greyish stained with yellow, which is the color of the first exuvia; second dull crimson, secretionary covering opaque white; scales circular, exuviae central.....*Howardia biclavis*
Female scale dark colored.....12

12. Female scale circular, 2.5 mm. diameter, moderately convex, blackish, entirely covered by the epidermis of the twig except the small shining sublateral orange-ferruginous exuviae.....*Pseudaonidia clavigera*
Female scale circular to broad oval, 1 mm. diameter, tolerably convex, pitch black; exuviae concolorous, very inconspicuous; placed toward the side.....*Morganella maskelli*
Female scale mytiliform, thin, flat and more or less transparent, 1.5 mm. long, color varying from pale brown to dark brown, exuviae terminal, rather dull copper colored and about one-fourth length of scale.....*Lepidosaphes hawaiiensis*

13. Female scale short oval to rectangular in outline, black.....*Parlatoria zizyphi*
Not so.....14

14. Female scale longitudinal.....15
Not so, circular, with exuviae in center.....24

15. Female scale filiform, six times as long as wide, black.....*Ischnaspis longirostris*
Female scale mytiliform.....16

16. Female scale with only one exuvia (the first) at basal extremity; small, brownish in color (common on avocado).....*Fiorinia fioriniae*
Not so; female scale with two exuviae at cephalic end.....17

17. Female scale not expanded or broadened much caudally.....18
Female scale narrow in front, broadened behind.....19

18. Female scale 2.5 mm. long, .5 mm. wide, very dark reddish brown, almost black, exuviae pale straw color, 2nd exuvia ⅝ mm. long, less than half as wide, secretionary portion of scale extending along sides half its length, 1st exuvia .25 mm. long, overlapping second very little (on maile).....*Lepidaspidis uniloba*
Female scale 1.5-2 mm. long, .5-1 mm. wide, brownish fulvous, semitransparent, paler at margin, exuviae clear yellow, occupying less than half total length of scale (on orchids, crotons).....*Parlatoria mytilaspiformis*

19. Female scale white, pyriform, exuviae pale fulvous.....*Phenacaspis eugeniae* var. *sandwicensis*
Female scale brown.....20

20. Female scale small, 2nd larval exuvia large, one-third length of scale.....*Pinnaspis buxi*
Not so, female scale normal.....21

21. Medium brown to dusky, caudal margin pallid.....*Lepidosaphes pallida*
Caudal margin not pallid.....22

22. Male scales white and tricarinate, wax felted.....*Pinnaspis minor* and *P. aspidistrae*
Male scales concolorous and without carinae.....23

23. Female scale long and narrow, more than three times as long as wide.... *Lepidosaphes gloveri*
Female scale shorter and wider, less than three times as long as wide *Lepidosaphes beckii*

24. Female scale dark colored.....25
Female scale light colored.....26

25. Female scale black with red nipple.....*Chrysomphalus aonidum*
Female scale without red nipple but with white dot in center..... *Chrysomphalus dictyospermi*

26. Female scale transparent, colorless, exuviae bright yellow..... *Aspidiotus cyanophylli*
Female scale pale yellowish gray, exuviae reddish, small spot and ring of white on nipple.....*Chrysomphalus aurantii*
Female scale white or pale ochreous, exuviae brownish yellow or straw colored .....*Aspidiotus lataniae*
Female scale grey ochreous, exuviae castaneous brown, white ring on nipple .....*Aspidiotus rapax*
Female scale dull ochreous, exuviae yellow.....*Aspidiotus hederae*

Key to Genera of Diaspinae in Hawaii

The following key to the genera is largely based on morphological characters which can only be made out in carefully prepared specimens with the aid of the compound microscope.

1. Caudal margin of adult female with a single, entire median lobe (median lobe undivided) 2
Caudal margin with median lobes at least (median lobes divided)..... 3

2. Scale and insect elongate.....*Lepidaspidis*
Not so, scale and insect round or oval.....*Odonaspis*

3. Median lobes of caudal margin divergent and serrate on inner edge.... 4
Not so, median lobes parallel and without serrations on inner edge.... 7

4. Adult female small, inclosed in the second exuvia, only one exuvia, that of the first larva, at basal extremity of scale, second present, however, but inclosing like a puparium the very much reduced adult female insect as stated..... *Fiorinia*
Not so; more than one exuvia at narrow end of female scale..... 5

5. Exuviae marginal, outline of scale subcircular, pyriform or elongate.... *Phenacaspis*
Exuviae within the margin of scale, which is circular..... 6

6. Dorsal tubular gland openings scattered, not arranged in distinct rows; median lobes rather widely separated.....*Diaspis*
Dorsal tubular gland openings arranged in distinct rows, inner margin of median lobes close together at base.....*Aulacaspis*

7. Female with slender, elongate, chitinous processes extending inward from base of lobes.....*Chrysomphalus*
Chitinous processes short or absent, or if longer, clubbed..... 8

8. With branched plates (bracteae) on some of the segments anterior to the pygidium, two rows of isolated pores near caudal margin of female ..... *Parlatoria*
   Without branched plates (bracteae) on segments anterior to the pygidium 9
9. Female scale circular or nearly so 10
   Female scale always elongate 13
10. Female scale with exuviae overlapping and placed at or close to anterior extremity, a conspicuous pair of stout, club-shaped paraphyses; lateres crowded with branched and spinous plates ..... *Howardia*
    Female scale with exuviae completely superposed and more or less centrally situated (in male as well) 11
11. Female with an extensive reticulated tract on the dorsal surface of the pygidium ..... *Pseudaonidia*
    Female without reticulated tract on dorsal surface of pygidium 12
12. Pygidium of adult female without genacerores ..... *Morganella*
    Pygidium of adult female with genacerores ..... *Aspidiotus*
13. Scale of female about 8 times longer than broad, sides nearly parallel ..14
    Scale of female less than 8 times longer than broad, narrow at the anterior end, broadening posteriorly 15
14. Pygidium of female with reticulations on dorsal surface ..... *Ischnaspis*
    Pygidium of female without reticulations on dorsal surface ..... *Tsukushiaspis*
15. Male scale with a thinner transverse band on cauda providing a hinge for the lifting of caudal end; median lobes of pygidium of female separated, usually with spines between 16
    Male scale not provided with a hinge, median lobes usually close together ..... *Pinnaspis*
16. Pygidium of adult female with paraphyses ..... *Andaspis*
    Pygidium of adult female without paraphyses ..... *Lepidosaphes*

The tribal affiliation of cited species is indicated in the species list which precedes. For a table of tribal distinctions, one is referred to MacGillivray's excellent manual. Consideration of the genera is next in order and for economy of space only a short generic characterization is made. Where reference can be given to an adequate description in coccid literature locally available the species are not described at length. In a few cases, however, it is necessary to do this and to add to completeness of treatment tables and figures are duly supplied.

Genus Parlatoria Targ.

Targ., Cat., p. 42 (1869).

This genus includes species of the Diaspinae having the scale of the adult female circular to oval in form, whitish to gray or black in color; exuviae marginal; body of the adult female ap-

proximately oval; pygidium with three pairs of well-developed lobes, the fourth somewhat developed and all more or less distinctly notched, at least on the outer side; a fringe of finely toothed plates between the lobes, and a series of thick-walled, broad-mouthed marginal glands placed parallel to the body margin; scale of the male oblong, non-carinated and rather narrow, with the exuvia placed at the anterior extremity.

So far as the author can ascertain we have but 3 species of this genus in Hawaii. They may be distinguished by the following key:

1. Scale of adult female with second exuvia of medium size, never covering one half of scale..... 2
   Scale of adult female with second exuvia large, covering two-thirds or more of scale, black; pygidium of adult female with lobes distant, median, second and third pairs bluntly rounded, entire; distapectinae broad, not truncate, approaching latapectinae in form; anus and vulva located near line drawn between pregenacerores and postgenacerores, altaceratubae about 17, one mesal and 8 on each side; genacerores (6-7), 7-10.....*zizyphi*
2. Scale of female circular or oval, never twice as long as wide, orange yellow, sometimes tinged with green; exuviae yellowish, darker than excretionary portion; lobes comparatively narrow, subconical, bluntly pointed, with more or less distinct mesal and lateral notches; pectinae broad and deeply toothed; altaceratubae 19, one mesal and 9 on each side; anus located midway between vulva and caudal margin; spiracerores wanting; genacerores (5-7); 4-7.....*proteus* var. *crotonis*
   Scale of adult female elongate with subparallel sides, more than twice as long as wide, brownish fulvous, exuviae yellow; lobes comparatively narrow, distant, end bluntly pointed with mesal, and lateral notches; fourth pair of lobes sometimes represented by rudiment; pectinae of median, second and third incisurae narrow, others wide; spiracerores wanting; genacerores (6-6) 5-5; brevaceratubae numerous; altaceratubae distinct one mesal and nine on each side; anus located midway between vulva and caudal margin.....*mytilaspiformis*

Genus Lepidosaphes Shimer

Tr. Am. Ent. Soc. I, p. 373 (1868).

This genus includes species of Diaspinae in which the scale of the adult female is elongate, narrowed in front and gradually broadening behind, more or less curved, variable in color but generally orange brown to dark brown, exuviae terminal, second one covered. Male scale similar to that of female, but much smaller and narrower, exuviae terminal. The posterior part of the scale is separated by a thin transverse band of secretion

which functions as a hinge, permitting the extremity of the scale to be raised so that the adult can emerge.

Body of adult female elongate also, margins of some of the segments often produced. Circumgenital gland orifices in five groups. A pair of median lobes well developed; second pair cleft to form two lobules, of which the inner is larger. No incisions or chitinous thickenings present. Gland spines are usually arranged as follows on either side median line: 2 between median lobes, 2, 2, 2 and 2. Anal opening small, relatively close to base of pygidium. Marginal gland orifices prominent, usually arranged as follows on either side median line: 1, 2, 2, and 1. Dorsal gland orifices present, arranged in 2-3 rows. Ventral thickenings distinct.

Type *L. ulmi* (Linn.).

Three species belonging to this genus are found in Hawaii, which may be differentiated with the following key:

1. An ear-like lateral lobe on either side at base of cephalic area; pygidium without plates in second incision ..... *auriculata*
   No ear-like lateral lobe present; pygidium with plates in second incision 2
2. Margin of penultimate and two preceding segments of body with chitinous spur; genacerores 4, 6, 4 ..... *gloveri*
   Margin of penultimate and two preceding segments of body without chitinous spur 3
3. Mesogenacerores never less than 5 ..... *beckii*
   Mesogenacerores never more than 4 ..... *pallida*

Genus Ischnaspis Douglas

Ent. Mo. Mag. XXIV, p. 21 (1887).

This monotypical genus of the Diaspinae is distinguished by the following characteristics: The scale of the adult female is extremely long and narrow, with the first exuvia extending beyond the anterior margin; black in color and shiny. The body of the adult female is very long and narrow, the posterior margin of the pygidium forming a regular shallow concave depression from which the median lobes project. The dorsal surface of the pygidium has a peculiar latticework design. Circumgenital glands in five small groups, sometimes, however, difficult to make out in their entirety. The male scale is elongate, similar to that of the second-stage female, and without the central hinge.

Type *I. longirostris* (Sign.).

I. longirostris is a fairly common species in Hawaii on palms.

Genus LEPIDASPIDIS MacGill.

Coccidae, MacGillivray, p. 292 (1921).

This genus is distinguished from Lepidosaphes by the fused condition of median lobes and absence of secondary ones. The genus is monotypic.

Single large mesal lobe crenulate; four distant plates on each side, cephalic two much larger than caudal two; genacerores present; caudal segments of preabdomen with two large plates; segments not deeply constricted.

Type not designated.

Only one species, viz. *L. uniloba* (Kuw.).

Genus ANDASPIS MacGill.

Coccidae, MacGillivray, p. 292 (1921).

This genus is distinguished from Lepidosaphes by the presence of paraphyses in the adult female and the absence of secondary lobes. The lobes are triangular, lateral margin long, minutely serrate, mesal notch small. Plates longer than the lobes, arranged 2, 1-2-2-1. Margin with six altaceratubae arranged 1, 2, 2, 1. Dorsal oraceratubae small, in two rows. Genacerores present.

Type not designated.

Only one species found in Hawaii, viz. *A. hawaiiesis* (Mask.).

NOTE: *Andaspis* (*Lepidosaphes*) *hawaiiensis* is not common in Hawaii—at least it has not been found in general collecting; yet in Florida this scale is common enough to be feared as a serious pest.

Genus AULACASPIS Cockerell

Journ. Inst. Jam. I, p. 180 (1893).

This genus includes species of Diaspinae in which the scale of the adult female is circular to oval, white, exuviae subcentral to submarginal. Scale of male small, elongate, parallel-sided, white, felted (wax), dorsal surface tricarinate or unicarinate. Body of the female elongate ovate, tapering posteriorly or (in aberrant species) subcircular; pallid with pygidium reddish brown, cephalothorax one-third to one-half the body; abdomen distinctly segmented.

Type *A. rosae* (Bouché).

There are three species belonging in this genus found in Hawaii, which may be differentiated by the use of the following key:

1. Adult female circular, lateral lobes undeveloped, circumgenital pores very numerous, each group 50 or more (on litchi).....*major*
   Adult female elongate, lateral lobes developed, circumgenital pores less numerous, all groups considerably less than 50..... 2
2. Inner margin of median lobes almost entire, six to seven gland spines on pygidial margin near penultimate segment (on Aglaia).....*fulleri*
   Inner margin of median lobes distinctly serrate, usually four gland spines on pygidial margin near penultimate segment (on rose).....*rosae*

Genus Diaspis Costa

Prospetto nuova Div. Met. Coccus p. 7 (1828).

This genus includes species of Diaspinae in which the scale of the adult female is circular or subcircular, exuviae situated well within the margin. The first exuvia is naked or with an almost imperceptible secretionary covering, the second exuvia occupies about one-fourth the diameter of the scale and is covered by a layer of secretion. The scale of the male is small, elongate, approximately parallel-sided, white, felted (wax), tricarinate, the exuvia at the cephalic end. Body of female oval or nearly so, yellowish tinged reddish or brownish, cephalothorax pronounced, rounded (bearing in *D. boisduvali* a prominent tubercle), segmentation of the abdomen rather indistinct. Pygidium with three pairs of well-developed lobes, the fourth obscurely developed; median lobes widely separated, deeply sunken into apex of pygidium, which really forms a concavity. Circumgenital gland orifices present fairly numerous, arranged in five groups. Marginal gland orifices present, arranged as follows on either side of the median line: 1 between median lobes, then 1, 2, 2, 1.

Type *D. calyptroides=echinocacti.*

Three species belonging to this genus are found in Hawaii, which may be differentiated with the following key:

1. Thoracic segment with a large projecting tubercle.....*boisduvali*
   Not so 2
2. Inner margin of median lobes free and serrate; dorsal gland orifices large .....*bromeliae*
   Both margins of median lobes free and non-serrate; dorsal gland orifices small and numerous.....*echinocacti*

Genus PHENACASPIS Cooley & Cockerell

Check List Coccidae, Suppl., p. 398 (1899).

This genus includes species of the Diaspinae in which the scale of the female resembles that found in the genus Chionaspis, that is to say, it is elongate, narrow in front, more or less broadened behind, white, exuviae terminal at the cephalic end. The scale of the male is much smaller than that of the female, elongated, parallel-sided, exuvia at anterior end, unicarinate or tricarinate. The pygidium of the female is also like that of Chionaspis except that the median lobes are well separated, more or less sunken into the apical margin of the pygidium and have their inner margins serrate or crenate and strongly divergent, leaving a distinct notch in the median line.

Type *P. nyssae* (Comst.).

There is but one species of this genus found in Hawaii, viz., *Phenacaspis eugeniae* var. *sandwicensis*. The variety is here described as new.

Phenacaspis eugeniae (Maskell) var. **sandwicensis** nov.

Scale of female pyriform, only slightly convex and indistinctly carinate; length 2.5 mm., greatest width 1.5 mm.; white, surface smooth, somewhat glabrous and showing only transverse lines of growth; exuviae at anterior, narrow end pale fulvous in color; second exuviae .75 mm. long, twice length of first and overlapping first half its length.

Scale of male elongate, sides parallel, tricarinate; white, (wax) felted, 1 mm. long, exuvia at anterior end pale fulvous, about .3 mm. long.

Body of female elongate ovate, 2 mm. long, less than 1 mm. wide, pale yellow, pygidium with brownish tinge posteriorly, antennae with basal knob cuspid internally, a long curved seta extending therefrom, dorsum posterior to a transverse line through apex of rostrum marked by two submedian, subparallel linear stomata diverging posteriorly. Anterior spiracles having well-defined parastigmatic glands and removed laterally from apex of rostrum a distance equal to width of latter at base. Posterior spiracles placed a little anterior to middle of body, about equidistant from each other and margin of body. Median lobes of the pygidium divergent at 90 degree angle and projecting one-third their length from an obtuse posterior notch, well separated at bottom where there are two setae (plates), outer portion of interior margin minutely dentate. Exterior to median lobes a seta and between them and the divided second lobes a plate, between the second pair of lobules and the broad truncate third pair also a seta and a larger plate, another seta at base of outer lobule. Beyond the lobules the margin is very irregular, bearing four stout plates, one directly beyond, two near together at anterior end and one about midway between; the two segments of the preabdomen anterior each bear three shorter plates on or near the lateral

margin. There is a submarginal row of brevaceratubae or marginal pores as follows: 1 between 1 and 2 lobes, 2 between 2 and 3 lobes, 2 between 1 and 2 plates on lateris, 2 between 2 and 3 plates and 1 between 4 and 6 small plates; and four segmental rows consisting of a median and a lateral portion proceeding caudad on 2nd segment: 4 median and 9 lateral, on 3rd, 5 median and 7 lateral, on pygidium 5 median (in two rows) and 4 lateral. Anus a little anterior to center of pygidium. Circumgenital glands in five groups as follows: anterior 8, anterior laterals 16, posterior laterals 21. Pygidium in stained specimens displaying fine striations and several rows of longitudinal darker markings similar to paraphyses, behind median lobes.

Genus PINNASPIS Cockerell

(HEMICHIONASPIS)

Journ. Inst. Jam. I, p. 136 (1892).

The species included in this genus have the scale of the adult female more or less pyriform in outline, with the exuviae at the anterior extremity. First exuvia naked, second more or less covered by secreted matter. Secreted portion varying from white to brown or yellowish. The body of the female is elongate, broadened posteriorly, conspicuously segmented. Abdominal segments with a more or less distinct group of small nearly circular gland orifices on each side, more distinct near the pygidium. More or less distinct rows of oval gland orifices on the dorsal surface between the segments. A group of gland spines on each side of the abdominal segments, more distinct near the pygidium than anteriorly. The characters of the pygidium are as follows: One, two or three pairs of lobes present. Median lobes with their inner edges straight, parallel, and close to each other or touching for their entire length, the outer edges being rounded and either crenate or serrate. These two lobes together form approximately a semicircle, and are darker than the other lobes. Lobes of the second and third pairs, when present, composed of two lobules, of which the inner is larger than the outer. Gland spines simple and usually quite large and conspicuous. Spines usually plainly visible; those on the dorsal longer than those on the ventral surface. Circumgenital gland orifices always present and arranged in five groups. Scale of male elongate, unicarinate or tricarinate: ventral scale complete forming with the upper part a tube.

Type *P. pandani=buxi* (Bouché).

There are three species belonging to this genus in Hawaii, which may be differentiated as follows:

1. Second exuvia large, occupying more than one-third the puparium....*buxi*
   Second exuvia not so large..... 2
2. Median lobes small, somewhat sunken into the pygidium.....*aspidistrae*
   Median lobes crenate.....*minor*

Genus Howardia Berlese & Leonardi

Riv. Pat. Veg. IV, p. 347 (1896).

This genus will contain the somewhat peculiar species of the Diaspinae characterized as follows: Scale of the adult female more or less oval to elongate, with the exuviae at or near the margin. Scalè usually covered by the outer layers of the bark of the host plant. Pygidium with median lobes well developed and with a pair of clubbed paraphyses. Circumgenital gland orifices wanting and without marginal gland orifices. Male scale unknown.

Type *H. biclavis* (Comst.).

There is but one species of this genus found in Hawaii, viz., the type species referred to above.

Genus Tsukushiaspis Kuwana

Imp. Jap. Dept. Agr. Sci. Bul. I, pt. 1, p. 30 (1928).

The species included in this genus of the Diaspinae have both female and male scales similar to those found in species of Chionaspis, that is, scale of the female elongate, narrow in front, more or less broadened behind, generally white or pale yellow, exuviae at the cephalic end; scale of the male small, elongate, slender, sides parallel or nearly so, white, generally tricarinate, exuvia terminal at the cephalic end. The body of the adult female is slender, sides nearly parallel, a more or less distinct row of oval gland orifices on the dorsal surface. Two pair of lobes present. Fimbriate processes (in the nature of squames) on the margin of the pygidium, shorter than lobes. No incisions or chitinous thickenings. Gland spines simple, much longer than lobes. Marginal gland orifices present, arranged as follows: 1 between the median lobes, on each side of the median lobes as 1, 1, 1. Anal opening small, nearer to the base than apex of pygidium. Circumgenital

gland orifices present, arranged in five groups. The distinctive characters are the presence of the fimbriate processes on the margin of the pygidium and the marginal gland orifice between the median lobes.

Type *T. pseudoleucaspis* (Kuw.).

There is but one species of this genus found in Hawaii, viz., the type species referred to above, which has previously been known as *Leucaspis bambusae*. It occurs commonly on a bamboo (*Phyllostachys* sp.).

Genus Fiorinia Targ.

Targ. Cat., p. 42 (1869).

The species included in this genus have but a single exuvia at basal extremity of female scale; the second is present but incloses the small adult female, the insect decreasing in size after second moult; the puparium so formed is more or less elongate narrow at the base, widening a little apically perhaps; sides, however, generally stated parallel, first larval exuvia extending beyond the margin. The male scales are white, elongate, with or without carinae, larval exuvia at anterior or basal extremity. Pygidium of adult female possessing well-defined median lobes (some species with a small pair on either side as well) and plates; circumgenital gland openings normally in five groups, although in some species the median and anterior laterals coalesce, forming an arch. Sometimes absent.

Type *F. fioriniae* Targ.

Two species belonging in this genus are found in Hawaii, which may be differentiated as follows:

With circumgenital gland openings, two pairs of lobes, spinous tubercles only on anterior portion of margin (on avocado) ..... *fioriniae*
Without circumgenital gland openings, only one pair of lobes, spinous tubercles along entire margin (on litchi) ..... *nephelii*

Genus Aspidiotus Bouché

Naturg. Schädl. Gart. Ins., p. 52 (1833).

This genus includes species of Diaspinae in which the scale of the female is circular or nearly so, with the exuviae at or near the center, and the scale of the male somewhat elongated, with

the larval skin at one side of the center or near one extremity. The last segment of the female usually presents four groups of spinnerets. In a few species there are five groups, and in some they are wanting.

Type *A. hederae* (Vall.).

Four species belonging to this genus are found in Hawaii, which may be differentiated with the following key:

1. Pygidium of adult female always without genacerores, scales grayish or yellowish.....*rapax* (*camelliae*)
   Pygidium of adult female always with genacerores..... 2
2. Pygidium of adult female always without densariae or paraphyses; scale very dull pale yellow, often whitish in well-protected specimens; thin, somewhat transparent; exuviae central, yellow, covered in newly molted adult females but usually bare in older individuals.....*hederae*
   Pygidium of adult female always with densariae or paraphyses..... 3
3. Pygidium of adult female with three pairs of lobes; scale brownish yellow; exuviae central, bright yellow, covered with white secretion .....*cyanophylli*
   Pygidium of adult female with a single pair of lobes; scale clear yellow, translucent at center, exuviae large.....*lataniae*

Genus Chrysomphalus Ashm.

Am. Ent. III, p. 268 (1880).

This genus of the Diaspinae includes the species similar in most respects to the species of Aspidiotus *supra;* however, there are always paraphyses present, and in that particular they are different.

Type *C. ficus* Ashm.

There are four species belonging to this genus found in Hawaii, which may be differentiated by the use of the following key:

1. Circumgenital gland openings absent, scale orange or reddish (on citrus) .....*aurantii*
   Circumgenital gland openings present in adult female..... 2
2. Two outer rows of dorsal gland openings numerous and each arranged in a double row; marginal plates beyond the third lobes strongly pectinate along their margins; scale blackish with the covered exuviae reddish (on citrus, Cycas, and coconut).....*aonidum* (*ficus*)
   Two outer groups of dorsal gland openings few in number and each arranged in a single row..... 3
3. A conspicuous pair of long, serrated plates laterad of third lobe; scale grayish-white, exuviae light yellow (on palms).....*dictyospermi*
   Not so; that is without a conspicuous pair of long, serrated plates laterad of third lobe; scale deep, dull brown, almost black, nipple yellowish (on Araucaria) .....*rossi*

Genus Odonaspis Leon.

Riv. Pat. Veg. V, p. 284 (1897).

Species included in this genus have the scale of the adult female circular or subcircular in outline with the exuviae placed to one side of the center. The scale of the male is more elongate and strongly convex above, exuviae near anterior extremity. Body of female is broadly oval, rather flat, with integument at caudal end strongly chitinized. Pygidium broad and triangular, terminating in a large and apparently single, fairly prominent median lobe, or the equivalent thereof; other lobes more or less indistinctly formed, merely indicated by lesser or slight prominences; no plates whatsoever but a few marginal spines present. Circumgenital glands usually present, also distinct paraphyses, and the pygidial area dotted with small pores or gland openings.

Type *O. secreta* (Ckll.).

Two species belonging to this genus are found in Hawaii, which may be differentiated with the following key:

Pygidium without incisions, anterior circumgenital glands 12-17, lateral 29-33, numerous dorsal pores on either side of median and second pair of lobes (on Bermuda grass) ..... *ruthae*

Pygidium with incisions, no anterior circumgenital glands, laterals in first group numbering 80-90, dorsal pores inconspicuous (on bamboo) *secreta*

Genus Morganella Cockerell

U.S.D.A. Bul. Ent. t.s. 6, p. 22 (1897).

This genus of the Diaspinae includes species similar in most respects to the species of Aspidiotus *supra,* but may be distinguished therefrom by the following characteristics: Closely adjacent or contiguous median lobes, which are long and slender, absence of other lobes, and orifice at base of lobes, and especially the very long spines.

Type *M. maskelli* (Ckll.).

There is but one species of this genus found in Hawaii, viz., the above-named type species, which some authorities consider the same as *M. longispina,* the other species included in the genus.

Genus PSEUDAONIDIA Cockerell

U.S.D.A. Bul. Ent. t.s. 6, p. 14 (1897).

The species included in this genus of the Diaspinae are similar in most respects to the species of Aspidiotus *supra*, but there is a peculiarity in the pygidium of the adult female: the dorsal surface has a latticework design like that in Ischnaspis.

Type *P. duplex* (Ckll.).

There is but one species of this genus found in Hawaii, viz., *P. clavigera* Ckll.

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Hymenopterous Parasites of the Coccidae, etc., in Hawaii

BY D. T. FULLAWAY

(Presented at the meeting of April 2, 1931)

PART I

Host List and Reference

Parasite	Host
Anagyrus swezeyi Timb. (1)*	*Trionymus insularis* Ehr.
† *Marietta graminicola* Timb. (2)	
" *nigricornis* Timb. (3)	*Trionymus insularis*
† *Marietta graminicola*	" *lounsburyi* (Brain)
	Pseudococcus longispinus (Targ.)
	Ripersia palmarum Ehr.
" *antoninae* Timb. (4)	*Antonina indica* Green
† *Marietta graminicola*	
† *Thysanus dactylopii* (Ashm.) (5)	
" *dactylopii* (How.) (6)	*Pseudococcus filamentosus* (Ckll.)
" spp.	Endemic spp. *Pseudococcus*
" *saccharicola* Timb.	*Trionymus sacchari* (Ckll.)
Leptomastidea abnormis (Gir.) (7)	*Pseudococcus krauhniae* (Kuwana)
Pauridia peregrina Timb. (8)	*Pseudococcus krauhniae*
Blepyrus insularis (Cam.) (9)	*Ferrisiana virgata* (Ckll.)
Protaenasius sp. (10)	*Ferrisiana virgata*
Coelaspidia osborni Timb. (11)	*Pseudococcus boninsis* (Kuwana)
† *Thysanus dactylopii*	
Encyrtus infelix (Embl.) (12)	*Saissetia hemispherica* (Targ.)
† *Quaylea whittieri* (Gir.) (13)	" *nigra* (Nietn.)
Encyrtus barbatus Timb. (14)	*Saissetia hemispherica*
	" *nigra*
Microterys kotinskyi (Ful.) (15)	*Coccus longulus* (Dougl.)
† *Quaylea whittieri*	" *viridis* (Green)
	Ceroplastes rubens Mask.
	Pulvinaria mammeae Mask.
	" *psidii* Mask.
	Saissetia nigra
" *flavus* (How.) (16)	Collected
Aphycus alberti How. (17)	*Coccus longulus*
" *claviger* Timb. (18)	Collected
" *terryi* Ful. (19)	*Pseudococcus boninsis*

* Numbers refer to citations of literature, Part II.
† Hyperparasite.

Pseudaphycus utilis Timb. (20)	*Pesudococcus nipae* (Mask.)
Aphycomorpha araucariae Timb. (21)	*Eriococcus araucariae* Mask.
Adelencyrtus odonaspidis Ful. (22)	*Odonaspis ruthae* Kot.
Anabrolepis extranea Timb. (23)	Collected ex diaspine
Anicetus annulatus Timb. (24)	*Eucalymnatus tessellatus* (Sign.)
Comperiella bifasciata How. (25)	*Aspidiotus rapax* Comst.
	" on bamboo
Arrhenophagus albipes Gir. (26)	*Phenacaspis eugeniae* (Mask.)
Xanthoencyrtus fullawayi Timb. (27)	*Pseudococcus boninsis*
" *apterus* Timb. (28)	*Trionymus insularis*
" spp.	
Plagiomerus hospes Timb. (29)	Diaspinae?
Tomocera californica How. (30)	*Saissetia nigra*
	" *oleae* (Bern.)
	Asterolecanium pustulans (Ckll.)
	Ceroplastes rubens
" *ceroplastis* Perk. (31)	*Ceroplastes rubens*
Scutellista cyaneae Mots. (32)	*Saissetia hemispherica*
† *Quaylea whittieri*	" *nigra*
	" *oleae*
Aneristus ceroplastae How. (33)	*Coccus longulus*
	" *viridis*
	Pulvinaria urbicola Ckll.
	Ceroplastes rubens
	Saissetia nigra
Coccophagus hawaiiensis Timb. (34)	*Saissetia nigra*
	Coccus viridis
" *ochraceus* How. (35)	*Coccus viridis*
Prospaltella koebelei How. (36)	*Morganella longispina* (Morg.)
" *bicolor* Timb. (37)	*Aspidiotus cydoniae* Comst.
	" *rapax*
" *transvena* Timb. (38)	*Aleyrodes vaporariorum* Westw.
	" *hibisci* Kot.
	" *sonchi* Kot.
	Aphis sacchari Zehnt.
Encarsia versicolor Gir. (39)	*Aleyrodes sonchi*
	" *vaporariorum*
" sp. (40)	" *sonchi*
	" *hibisci*
	" *vaporariorum*
Aspidiotiphagus citrinus (Craw) (41)	*Diaspis bromeliae* (Kern.)
	" *echinocacti* Comst.
	Aulacaspis rosae (Bouché)
	Parlatoria zizyphus (Lucas)
	Pseudoparlatoria giffardi
	Chrysomphalus aonidum (Linn.)
	" *rossi* (Mask.)
	Lepidosaphes auriculata (Green)

Aspidiotiphagus citrinus (Craw) (41)	*Lepidosaphes beckii* (Newm.)
	Aspidiotus perniciosus Comst.
	" *hederae* (Vall.)
	" *cyanophylli* Sign.
	Phenacaspis eugeniae
	Hemichionaspis minor (Mask.)
Aspidiotiphagus agilior Berl. (42)	*Parlatoria zizyphus*
	Fiorinia fioriniae (Targ.)
	Lepidosaphes beckii
Coccidencyrtus ochraceipes Gahan (43)	*Diaspis boisduvali* Sign.
Aphelinus maidis Timb. (44)	*Aphis maidis* Fitch
† *Aphidencyrtus inquisitor* (How.) (45)	" *sacchari*
" *gossypii* Timb. (46)	" *gossypii* Glover
	" *medicaginis* Koch.
" *semiflavus* How. (47)	*Toxoptera aurantii* (Fons.)
	Aulacorthrum circumflexum (Buck.)
Aphytis diaspidis (48)	*Howardia biclavis* (Comst.)
† *Marietta carnesi* (How.) (49)	*Diaspis bromeliae*
	" *echinocacti*
	Aulacaspis rosae
	Hemichionaspis minor
	Aspidiotus cydoniae Comst.
	Pinnaspis buxi (Bouché)
Aphytis chrysomphali (Mercet) (50)	*Diaspis bromeliae*
	Aspidiotus cyanophylli
	" *rapax*
	" *cydoniae*
	Hemichionaspis minor
	Chrysomphalus aonidum
	" *rossi*
	Lepidosaphes auriculata
	" *beckii*
	Pseudoparlatoria giffardi
Eretmocerus corni Hald. (51)	*Aleyrodes hibisci*
Archenomus perkinsi (Ful.) (52)	*Morganella longispina*
	Leucaspis indica
Pseudopteroptrix imitatrix Ful. (53)	*Howardia biclavis*
	Aspidiotus rapax
Signiphora aspidioti Ashm. (54)	" *cyanophylli*
	" *cydoniae*
" *thoreauini* Gir. (55)	Collected. Found in California
" sp. (56)	*Parlatoria* sp.
Astichus cyaneus Ashm. (57)	Collected

PART II

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PART III

Keys Useful in the Discrimination of Species

Key 1

To Subfamilies Encyrtidae
Aphelinidae
Signiphoridae
Pteromalidae

(including all the hymenopterous parasites of Coccidae, etc., in Hawaii)* viz:—

Chalcids with the thorax not strongly developed, pronotum small, frequently not visible in the middle, with hind femora not greatly enlarged, with hind wings not linear, not pedunculate at base, with ovipositor usually issuing in front of tip of abdomen, with antennae 5-13 jointed, 1, 2 or 3 of which may be ring joints, and generally elbowed, with tarsi 4 or 5 jointed, hind tibiae sometimes with a large curved spur.

1. Mesoternal pleurae not visible; mid-legs long, saltatorial, with a very long tibial spur 2
   Mesosternal pleurae distinct, mid-legs not saltatorial, first tarsal joint not swollen 3
2. Antennae 6-jointed, marginal vein about as long as subcostal ..... *Signiphoridae*
   Antennae 11-jointed, occipital margin of vertex usually acute; notauli obliterated ..... *Encyrtidae*
3. Antennae 13-jointed with two ring-joints and 3 joints to the club; occipital line incomplete ..... *Pteromalidae*
   Antennae never more than 8-jointed; notauli distinct; middle tibial spur moderately long ..... *Aphelinidae*

* In limiting scope of keys to four subfamilies of Chalcidae *supra*, following hymenopterous parasites of Aphidae left out of consideration:

Lysiphlebus testaceipes
Ephedrus incompletus
Diaeretus rapae
Pachyneuron siphonophorae
Eucoila sp.

Key 2

To Species of Signiphora (monotypical)

1. With a well-developed discal bristle on fore-wing, antennal club proportionately shorter and wider ..... sp. indet.
   Without discal bristle on fore-wing, antennal club proportionately longer and narrower 2
2. Antennal club all black, cephalic mesoscutum only slightly darkened, band on abdomen shorter ..... *thoreauini*
   Only apical half antennal club dark, anterior half mesoscutum and broad transverse band at base of abdomen dark brown, wings with broad fuscous band ..... *aspidioti*

Key 3

To Encyrtid Species

Females

1. Antennae compressed, short and wide relatively 2
   Not so 5
2. Ochraceous-orange species ..... *Anicetus annulatus*
   Blue-black to green or metallic-brown 3
3. Wingless, metallic brown ..... *Coelaspidia osborni*
   Not so, winged 4
4. Pedicel and funicle joints more or less terete ..... *Protaenasius* sp.
   Pedicel and funicle joints not terete, wings with fuscous rays ..... *Comperiella bifasciata*
5. Head broad or thick (fronto-occipitally), face and fronto-vertex not in the same planes 6
   Not so; head thin, or fronto-vertex and face more or less confluent 16
6. Anterior margin of the fronto-vertex carinate 7
   Not so 9
7. Submarginal vein much thickened just before its apex and very slender before the thickening ..... *Pauridia peregrina*
   Without this thickening in the submarginal vein 8
8. Fronto-vertex nearly but not quite as wide as long ..... *Aphidencyrtus inquisitor*
   Fronto-vertex wider than long ..... *Coccidencyrtus ochraceipes*
9. Forewings marked with fuscous rays ..... *Anabrolepis extranea*
   Not so 10
10. Forewings banded ..... *Microterys kotinskyi*
    Not so 11
11. Forewings with infuscated areas ..... *Adelencyrtus odonaspidis*
    Forewings clear 12
12. Ovipositor exserted ..... *Quaylea whittieri*
    Not so 13
13. Antennae white-tipped 14
    Antennae black-tipped 15
14. Orange-yellow species ..... *Pseudaphycus utilis*
    Fuscous gray-brown species ..... *Aphycus terryi*

15. Black band and spot on antennal scape.....*Aphycus alberti, claviger*
No band or spot on antennal scape.....*Aphycomorpha araucariae*
16. Antennae long, slender, filiform..... 17
Not so 23
17. Antennae with scape same diameter and thickness as flagellum..... 18
Antennae with scape compressed and more or less expanded..... 19
18. Wingless species.....*Xanthoencyrtus apterus*
Winged, and wings banded with fuscous discal ciliation.....
.....*Leptomastidea abnormis*
19. Antennal scape compressed, but not greatly expanded..... 20
Antennal scape much expanded, more than ½ as wide as long..... 21
20. Antennal scape about ⅓ as wide as long, black banded on white.....
.....*Anagyrus swezeyi*
Antennal scape about one-half as wide as long, not banded, black with a white line on dorsal edge forming a collar at distal end, white on distal half pedicel and entirely white beyond 1st funicle joint.....
.....*Anagyrus saccharriola*
21. Antennae white beyond 2nd funicle joint.....*Anagyrus dactylopii*
Not so 22
22. Antennae black except for two white bands on scape.....
.....*Anagyrus nigricornis*
Antennae white-tipped (all of club), otherwise mostly black (only a white band apex scape, white pedicel except at base and whitish on parts of 5th and 6th funicle joints).....*Anagyrus antoninae*
23. Wings clear, no hair tufts on scutellum..... 24
Wings fuscous, tuft of hairs on scutellum..... 25
24. Antennae 3-jointed.....*Arrhenophagus albipes*
Antennae 11-jointed.....*Blepyrus insularis*
25. Face distinctly lineolate, beard on cheeks long and conspicuous.....
.....*Encyrtus barbatus*
Not so.....*Encyrtus infelix*

Key 4

To Species of Aphelinidae

Females

1. Tarsi 5-jointed 2
Tarsi 4-jointed 19
2. Forewings with an obliquely transverse hairless line below stigma.... 3
Forewings without this hairless line below stigma..... 9
3. Wings mottled 4
Not so 5
4. Antennal scape broadly expanded beneath, width nearly half the length (excluding radicle) and twice width of pedicel.....*Marietta graminicola*
Antennal scape slender, no wider than pedicel.....*Marietta carnesi*
5. Head and thorax not differing greatly in width, ovipositor comparatively strong and entirely free so that in oviposition it descends almost perpendicularly from near the base of the abdomen..... 6

Head broad, body tapering behind to the apex of the abdomen, ovipositor comparatively tenuous and enclosed entirely by the ventrites so that in oviposition it is protruded backward in a more or less horizontal position 7

6. Lemon-yellow species, wings clear, discal ciliation base of wings sparser..... *Aphytis chrysomphali*

Orange-yellow species, wings and abdomen somewhat fuscous, discal ciliation wings close and fine..... *Aphytis diaspidis*

7. Body partly black or brown, speculum of forewing bounded basad by several rows of setae..... 8

Speculum banded basad by one and one-half rows of setae or by one row and several more or less scattered setae just beneath the marginal vein; abdomen yellowish on basal segment..... *Aphelinus gossypii*

8. Wings large and comparatively wide, the disc beyond the speculum finely and densely pubescent, the marginal fringe comparatively short and often inconspicuous..... *Aphelinus maidis*

Wings comparatively small and narrow, the stigmal vein reaching far beyond the middle of the costal margin, the disc beyond the speculum with coarser, sparser setae, the marginal fringe comparatively long and conspicuous; abdomen except the lateral margins usually wholly yellow; the male with elongate antennae, the third funicle joint not much shorter than the long, slender club..... *Aphelinus semiflavus*

9. Antennae 7-jointed (scape, pedicel, 4 ring joints and a moderately long club)..... *Thysanus dactylopii*

Antennae 8-jointed 10

10. Antennal club 2-jointed..... 11

Antennal club 3-jointed..... 12

11. Pale cadmium yellow species marked with variable dusky, basal half of forewings which are narrow, slightly dusky, naked area beyond and below stigmal vein reaching costal edge, bare path also around margin apical half wing, marginal fringes of forewings long, especially caudo-apically..... *Encarsia versicolor*

Bright yellow species with wings wholly hyaline, disc of wing rather broad, without a bare area beyond the stigmal vein, marginal fringe less than one-half width of disc..... *Encarsia* sp.

12. Stigmal vein lacking, wings with a very long fringe..... 13

Stigmal vein present, marginal cilia comparatively short..... 14

13. Antennae longer, anterior wings proportionately larger, discal ciliation closer, more extensive, infuscation deeper..... *Aspidiotiphagus citrinus*

Antennae shorter, anterior wings proportionately smaller, discal ciliation sparser and less extensive, infuscation fainter..... *Aspidiotiphagus agilior*

14. Marginal vein shorter than the submarginal..... 15

Marginal vein as long as or longer than the submarginal..... 17

15. Black species with pale yellow scutellum..... *Prospaltella bicolor*

Not so 16

16. Orange yellow species with yellow antennae, hyaline wings and long marginal fringes.....*Prospaltella transvena*

Varicolored species: abdomen and pronotum brown, head entirely yellow, meso and metanotum dark yellow, legs pallid except hind femora which are dusky, antennae yellow, pedicel and last two funicle joints darker, wings hyaline, disc forewings below marginal vein faintly infuscated.....*Prospaltella koebelei*

17. Antennal scape short, flagellum shortly flattened, hind tibiae flattened and with a row of short bristles above.....*Aneristus ceroplastae*

Antennal scape not especially short, flagellum subcylindrical, hind tibiae normal 18

18. Ochraceous or dark honey yellow, antennae yellowish except pedicel, which is blackish, legs concolorous with thorax; antennae moderately long, first funicle joint only a little longer than wide; wings hyaline, veins fuscous.....*Coccophagus ochraceus*

Black, rather shiny on thorax and abdomen, scutellum except basal third and very narrow metanotum yellow; scape dusky yellowish, flagellum piceous, middle and hind coxae and hind tibiae yellowish white, front coxae and front femora, middle femora and tibiae in large part and hind femora except basal third more or less brownish or fuscous; antennae longer, first funicle joint more than twice as long as wide; wings hyaline and very faintly tinged with fuscous, veins yellowish.....*Coccophagus hawaiiensis*

19. Antennae 5-jointed, funicle joints 1 and 2 ring joints (male antennae 3-jointed, club very long, bent).....*Eretmocerus corni*

Antennae 8-jointed 20

20. Club 3-jointed, funicle joints about the same length widening a little outwardly.....*Pseudopteroptrix imitatrix*

Club 3-jointed, second funicle joint transverse, only half the length of 1st and 3rd.....*Archenomus perkinsi*

Key 5

To Pteromalid Species

1. Scutellum exceptionally large, five times as long as pronotum, extending out over the abdomen to its middle, head broad and short, seen from in front triangular, antennae attached beneath middle of face, 8-segmented, scape fairly long, cylindrical, pedicel nearly as long as two first segments flagellum, these as long as broad, the following segments becoming somewhat shorter and broader, club not divided, as long as the three preceding segments together, pronotum very short with sharp anterior margin, parapsidal furrows complete and well marked, radial vein of wings shorter than the marginal, postmarginal half its length, abdomen short oval, as long as head and thorax together, 1st segment occupying first half, ovipositor only a little protruding.....*Scutellista cyanea*

Scutellum not exceptionally large and not extending beyond the thorax 2

2. A fascia of hairs on either side at base of abdomen (on 2nd segment), head large and wide, strongly incised behind, antennae 10-segmented, marginal vein scarcely longer than the radius, postmarginal absent, 2nd segment of abdomen very large, occupying largest part of dorsum, antennae of male toothed.....*Tomocera californica*

Without two large subcircular (apparently slightly raised) areas of very dull appearance owing to covering of minute microscopic tomentum as in *californica,* hind coxae never dark and metallic on basal part, uniformly testaceous or brownish yellow, the large post-petiolar segment of abdomen uniformly smooth.....*Tomocera ceroplastis*

The Biological Control of the Coconut Moth (*Levuana iridescens* Beth.-Baker) in Fiji—Book Review

BY F. MUIR

(Presented by O. H. Swezey at the meeting of May 7, 1931)

The publication of "The Coconut Moth in Fiji," by Messrs. J. D. Tothill, T. H. C. Taylor and R. W. Paine, is a notable event in the history of biological control of insect pests. It is of interest to entomologists in Hawaii for the reason that they have had personal contact with the entomologists of Fiji for a number of years, and there has been a number of return visits between them. Thus they have come to know one another's problems fairly well.

In 1905, when I first visited Fiji, this moth was confined to a part of the island of Viti Levu, although it had then been known in the island for nearly thirty years. It was then causing the authorities anxiety, and I was consulted by the Governor, and the Superintendent of Agriculture, as to possible remedies. I advised biological control measures, and suggested some of the islands in the Southwest Pacific as the probable home of the moth, and therefore the most likely place to find suitable parasites. I believe Albert Koebele had given similar advice some months earlier. The Governor, who was also a well-known zoologist, appeared interested in the idea, but it was twenty years before the advice was acted upon. It would be interesting to know the various reasons for the long delay. One reason, I feel quite sure, was the attitude of antagonism of most economic entomologists to biological control in 1905, and for some ten or fifteen years after. Except for a small group of entomologists in the United States, a small group in Hawaii and a few individuals in Europe, the whole of the economic entomological world was opposed to this principle of control. In 1910, a leading British economic entomologist told me that I was a fool for wasting my time; that I should do no good, but a lot of harm. Time brought a change, and this entomologist lived to advocate biological control himself, although he never had a proper understanding of the subject.

One of the factors bringing about this change was the economic success attained in the Hawaiian Islands.

It is possible that this coconut pest could have been controlled by artificial means, but the expense would have been greater than the industry could bear.

One of the things that has been brought out in the report is the gregariousness of *Levuana iridescens* Beth.-Baker, but I do not think enough use has been made of this to account for its slow rate of spread, and for some of its most marked characteristics. The larvae, upon hatching from the eggs, do not disperse, but feed together, and only the exhaustion of the food compels them to move to another leaf; even when full-grown they do not seek solitude to pupate, like so many moth larvae, but congregate in masses to such an extent as to lead to the death of many pupae.

The adult has well developed wings and, if endowed with a wanderlust, would soon have spread over Viti Levu, and even to other islands; but it has a strong nostalgia and will not seek new quarters, even to oviposit, but prefers leaves upon which Levuana larvae are feeding. This leads to the enormous Levuana population in small areas, to the destruction of all its food plant and to the great economic loss; it also is accountable for the very slow spread of the insect. This pyschology also played an important part in the control by the introduced Tachinid (*Ptychomyia remota* Ald.), as the percentage of parasitism as a rule, can rise higher in dense than in sparse populations.

We have a somewhat parallel case in Hawaii in *Anomala orientalis* (Waterh.). This beetle spread very slowly, and increased to enormous numbers in the area of infestation. When the Anomala population became very dense it was often decimated by bacteria. The adult is a good flyer and it was a problem to account for its slow spread, as they were taken feeding on several plants. It was soon found that only males, and females that had already oviposited, frequented flowers; it was seldom that a gravid female was taken feeding. Mating takes place as soon as the female matures, and she deposits her eggs in the vicinity. This was an important factor in its control by *Scolia manilae* Ashm., as the parasite did not have to expend much energy in seeking its host. Thus we see a parallelism due to different causes.

Ptychomyia remota is not a native parasite on *Levuana iridescens,* but is attached to other, but allied, genera in Java and Malay States; *Scolia manilae* is also attached to allied species of Anomala in the Philippines, where *A. orientalis* is unknown. These two parasites have perfect control over their hosts in their new habitats. This indicates that it may be possible to use a foreign parasite to control a native insect under certain conditions.

It is fortunate, from a scientific viewpoint, that no other death factor of importance was established along with *Ptychomyia remota,* as it demonstrates once more what a single parasite can achieve under favorable conditions. Tachinids have a wonderful faculty of finding their hosts, and therefore their critical point of parasitism is often high. The Tachinid on our own sugar cane beetle borer finds its hosts, although they are embedded in the stalk of the sugar cane. The fecundity of *Ptychomyia remota* is very much lower than that of *Ceromasia sphenophori* Vill., but then the former places its eggs upon its host, whereas the latter has to deposit them in the runs of the beetle borer larvae, and the Tachinid grubs have to find their host for themselves. The more direct the contact between the host and parasite, the less need for high fecundity.

As *P. remota* has alternate hosts in Fiji it is likely to spread beyond the range of Levuana, and so be on the spot, should Levuana spread. This is the case with *Scolia manilae,* which exists on Adoretus far beyond the present range of Anomala.

The account of Chalcid B and Chalcid A on Artona in Java (p. 240), and the injurious effects the latter has upon the former, recalls the limiting effect the hyperparasite has upon the Dryinidae in Hawaii.

In studying the Levuana work in Fiji, entomologists in Hawaii will find a number of phases of interest, on account of their similarities to those of their own work.

As the three authors spent some time in Hawaii, it is strange that the only reference to the work here is incorrect. They state that the beetle borer (*Rhabdocnemis obscura* [Boisd.]) threatened to destroy the sugar industry in Hawaii, and that its parasite (*Ceromasia sphenophori*) was introduced from Java. This Tachinid parasite is not known in Java, but in Amboina, Ceram and New Guinea, and was introduced from the last-mentioned locality. The

beetle borer has been in Hawaii for over sixty years and the sugar industry expanded in spite of it. It is true that it exacted a heavy toll during all these years, but it never threatened the life of the industry. It was the leafhopper (*Perkinsiella saccharicida* Kirk.) that did this, and *Anomala orientalis* might have ruined some of the most fertile areas of the Islands, if it had not been controlled.

"The Coconut Moth in Fiji" is published in a beautiful manner, the letter press and illustrations being exceedingly good. The Imperial Institute of Entomology must be given the credit for this.

The entomologists in Hawaii, through considerable experience, are well acquainted with the difficulties and dangers of all such work, and they congratulate all those who took part in finding and introducing and establishing *Ptychomyia remota* in Fiji.

Irritation Caused by the Sting of the Bethylid Wasp, Holepyris Hawaiiensis Ashm.

BY C. E. PEMBERTON

(Presented at the meeting of Sept. 3, 1931)

During June and July, 1931, a family resident on the beach at Niu, Honolulu, has been greatly annoyed by the irritation resulting from stings by a small bethylid wasp, determined by Dr. F. X. Williams as *Holepyris hawaiiensis* Ashmead.

This little wasp was found to occur rather commonly about the house and was no doubt breeding upon some small lepidopterous larva occurring either in the woodwork of the house, in stored foods or in dried and broken Algaroba seed pods, *Prosopis juliflora,* or other vegetation which is abundant and adjacent to the house. The host larva was not found. The insect was found in the bed clothing and in and on the clothes of the persons concerned. It stung readily when crushed or held in the clothing against the skin. Since it naturally searches in crevices and concealed places in search of its host, it frequently gets into clothing and bedding.

The immediate sensation following attack is comparable to that of an exaggerated mosquito bite. However, the itching and slight smarting of the affected spot usually lasts for several days and is accompanied by a swelling or welt a half inch or more in diameter which terminates as a dark blotch on the skin which may last for one or two weeks.

Similar, but much more violent effects have been caused in California by a somewhat similar bethylid wasp, *Epyris* sp., near *clarmontis* Kieffer. This has been described in detail in Science, Vol. LXV, No. 1682, pp. 302-303, March 25, 1927.

Holepyris hawaiiensis was found in quantity in the warehouses of the Union Feed Company in Honolulu in December, 1919, by J. C. Bridwell, where lepidopterous insects favoring stored food

products were common. E. M. Ehrhorn has reared it from *Ephestia cautella.*

This species has been studied by J. C. Bridwell and Dr. F. X. Williams. An account of its habits by Bridwell appears in Proc. Haw. Ent. Soc., Vol. IV, No. 2, pp. 311-14, 1919.

The Host Trees of the Endemic Cerambycidae in Hawaii

BY O. H. SWEZEY

(Presented at the meeting of May 7, 1931)

At the present time there are known 82 species and 4 varieties of endemic Cerambycidae in the Hawaiian Islands. They are distributed in the following genera: Plagithmysus, 49 species and 2 varieties; Nesithmysus, 4 species; Aeschrithmysus, 2 species; Callithmysus, 2 species and 1 variety; Neoclytarlus, 22 species and 1 variety; Paraclytarlus, 3 species. The descriptions of these are somewhat scattered, and many of them have no definite reference to their host trees. There are scattered notes recording habits of some of them later than the time of description. It seems desirable for convenient reference for those making further studies of this group of beetles, to have a list of all species together with their hosts so far as known. The following list also cites the decription, synonomy, collector and the island on which the species occurs. So far, no species is known to occur on more than one island. The list is arranged in chronological order according to dates of descriptions. A few host and locality records have been added while this paper was in press.

Plagithmysus pulverulentus (Motsch.).

Stenopterus pulverulentus Motschoulsky, Bull. Mosc., XVIII, I, p. 85, Pl. I, f. 12, 1845.
Plagithmysus pulverulentus Motsch., Bull. Mosc., XVIII, II, p. 370, Pl. VII, f. 7, 1845.
Plagithmysus pulverulentus, Sharp, Ent. Mo. Mag., (2), VII, p. 242, 1896.
Clytarlus robustus Sharp, Trans. Ent. Soc., London, p. 206, 1878.
Plagithmysus pulverulentus, Sharp, Fauna Hawaiiensis, II, p. 107, 1900.

Generally distributed on OAHU. Collected from *Acacia koa* by Blackburn and Perkins. Bred from the same tree by Swezey, Bridwell and Hadden. Oahu (Koebele); Wailupe (Bridwell); Tantalus (Giffard).

Plagithmysus cristatus (Sharp).

Clytus attenuatus Boisd., Voy. Astrol., Ins. II, p. 485, 1835.
Clytarlus cristatus Sharp, Trans. Ent. Soc., London, p. 207, 1878.
Plagithmysus cristatus Sharp, Ent. Mo. Mag., (2) VII, p. 274, 1896.

Plagithmysus cristaus Sharp, Fauna Hawaiiensis, II, p. 113, 1900.
Callithmysus cristatus Sharp, Fauna Hawaiiensis, III, p. 650, 1910.
Plagithmysus cristatus, Perkins, Proc. Haw. Ent. Soc., VI, p. 479, 1927.

Generally distributed on OAHU. Collected on *Acacia koa* by Blackburn and Perkins. Bred from the same tree by Swezey and Hadden. Oahu (Koebele); Tantalus (Giffard); Palolo, Punaluu (Swezey).

Plagithmysus finschi (Harold).

Clytarlus finschi Harold, Mitt. München Ent. Ver., IV, p. 166, 1880.
Plagithmysus finschi, Sharp, Ent. Mo. Mag., (2), VII, p. 242, 1896.
Plagithmysus finschi, Sharp, Fauna Hawaiiensis, II, p. 106, 1900.

Olinda and Haleakala, MAUI. Collected on *Acacia koa* by Blackburn and Perkins. Bred from the same tree by Swezey. Maui (Koebele); Olinda (Giffard and Fullaway).

Plagithmysus pulvillatus (Karsch).

Clytarlus pulvillatus Karsch, Berlin Ent. Zeit., XXV, p. 9, Pl. I, f. 14, 1881.
Plagithmysus pulvillatus, Sharp, Fauna Hawaiiensis, II, p. 111, 1900.

"Grove Ranche", MAUI (Karsch). Collected by Perkins on Haleakala, 5,000 ft. Maui, on *Metrosideros polymorpha.*

Plagithmysus blackburni (Sharp).

Clytarlus blackburni Sharp, Trans. Dublin Soc., (2), III, p. 195, Pl. V, fig. 47, 1885.
Plagithmysus blackburni Sharp, Ent. Mo. Mag., (2), VII, p. 271, 1896.
Plagithmysus blackburni Sharp, Fauna Hawaiiensis, II, p. 111, 1900.

Kona and Puuwaawaa, HAWAII. Collected on *Sophora chrysophylla* by Perkins and Giffard; by Blackburn on *Acacia falcata* (possibly a misidentification of tree); by Meinecke on Sophora on Mauna Kea, and at Humuula on dead Gouldia; by Williams and Swezey on Sophora at 7,000 feet elevation, Nauhi Gulch, Hawaii, Oct., 1931.

Plagithmysus vitticollis Sharp.

Sharp, Ent. Mo. Mag., (2), VII, p. 240, 1896.
Sharp, Fauna Hawaiiensis, II, p. 105, Pl. VI, fig. 5, 1900.

Kilauea, HAWAII (Perkins, Giffard, Swezey). Collected on akala (*Rubus* sp.) by Perkins; on *Perrottetia sandwicensis* by Giffard. Bred from *Rubus hawaiiensis,* Upper Hamakua Ditch trail, Kohala Mts. (Swezey).

Plagithmysus vitticollis var. longulus Sharp.
Sharp, Ent. Mo. Mag., (2), VII, p. 240, 1896.
Sharp, Fauna Hawaiiensis, II, p. 105, 1900.

Puna, HAWAII. Found breeding in *Bobea elatior* by Perkins. Collected on the same tree at Kilauea by Giffard. Collected at Puna by Newell; Hawaii (Koebele).

Plagithmysus newelli Sharp.
Sharp, Ent. Mo. Mag., (2), VII, p. 240, 1896.
Sharp, Fauna Hawaiiensis, II, p. 105, Pl. VI, fig. 7, 1900.

Wailuku, MAUI. Collected by Blackburn. Host tree unknown. Haleakala, 4,000 feet (Giffard).

Plagithmysus concolor Sharp.
Sharp, Ent. Mo. Mag., (2), VII, p. 241, 1896.
Sharp, Fauna Hawaiiensis, II, p. 106, Pl. VI, fig. 8, 1900.

KAUAI. Collected on ohia ha (*Syzygium sandwicense*) by Perkins and oviposition was observed on this tree; collected by Munro at Kaholuamano; Waimea, 3,200 to 4,000 feet, Kaholuamano (Giffard); Kaholuamano, Waialeale trail (Kusche); collected on ohia lehua by Osborn at Kokee. Bred from lehua at Halemanu by Swezey, July, 1932.

Plagithmysus solitarius Sharp.
Sharp, Ent. Mo. Mag., (2), VII, p. 241, 1896.
Sharp, Fauna Hawaiiensis, II, p. 106, 1900; III, p. 647, 1910.

Mt. Tantalus, Nuuanu, Pupukea, Haleauau, OAHU. Bred from *Syzygium sandwicense* by Perkins and Swezey; and from *Elaeocarpus bifidus* by Swezey and Hadden; on Tantalus, once bred from *Metrosideros polymorpha* by Perkins; Oahu (Koebele); Lanihuli (Bryan). Bred from lehua in Mohiakea Valley, Waianae Mountains, by Swezey, Sept., 1932.

Plagithmysus cuneatus Sharp.
Sharp Ent. Mo. Mag., (2), VII, p. 241, 1896.
Sharp, Fauna Hawaiiensis, II, p. 106, Pl. VI, fig. 9, 1900.

Kaala, OAHU. Collected by Perkins on an unknown tree; collected by Forbes on *Sapindus oahuensis* at Wailupe. Bred from the same tree at Niu by Swezey and Williams, March, 1932.

Plagithmysus bishopi Sharp.
Sharp, Ent. Mo. Mag., (2), VII, p. 242, 1896.
Sharp, Fauna Hawaiiensis, II, p. 108, Pl. VI, fig. 12, 1900; F. H., Int., p. lxviii, 1913.

Kilauea, HAWAII. Bred by Perkins from *Pelea cinerea* and *Xanthoxylum dipetalum* var. *geminicarpum*; collected from the same trees by Giffard; also collected by Giffard on *Pelea zahlbruckneri, Straussia* sp. and *Acacia koa.*

Plagithmysus bishopi var. **gracilis** Sharp.
Sharp, Ent. Mo. Mag., (2), VII, p. 243, 1896.
Sharp, Fauna Hawaiiensis, II, p. 108, 1900.

Kilauea, HAWAII. Collected by Perkins from a tree resembling pua (*Osmanthus sandwicensis*).

Plagithmysus vicinus Sharp.
Sharp, Ent. Mo. Mag., (2), VII, p. 243, 1896.
Sharp, Fauna Hawaiiensis, II, p. 108, 1900; F. H., Int., p. lxviii, 1913.

Western side of Mauna Loa, HAWAII. Collected from a different species of Pelea than that from which *bishopi* was bred.

Plagithmysus bilineatus Sharp.
Sharp, Ent. Mo. Mag., (2), VII, p. 243, 1896.
Sharp, Fauna Hawaiiensis, II, p. 108, Pl. VI, fig. 14, 1900.

Kilauea, Puna and Kona, HAWAII. Collected on ohia lehua (*Metrosideros polymorpha*) by Perkins; collected on the same tree at Kilauea by Giffard.

Plagithmysus lanaiensis Sharp.
Sharp, Ent. Mo. Mag., (2), VII, p. 244, 1896.
Sharp, Fauna Hawaiiensis, II, p. 108, 1900.

Halepaakai, LANAI. Collected by Perkins and said to be probably attached to ohia lehua.

Plagithmysus perkinsi Sharp.
Sharp, Ent. Mo. Mag., (2), VII, p. 244, 1896.
Sharp, Fauna Hawaiiensis, II, p. 109, Pl. VI, fig. 15, 1900.

Mauna Loa and Kilauea, HAWAII. Collected on *Myoporum sandwicense* by Perkins and Giffard; bred from the same tree by Giffard and Swezey. Bred from the same tree at Nauhi Gulch, 6,000 ft., by Swezey, Sept., 1931.

Plagithmysus varians Sharp.
Sharp, Ent. Mo. Mag., (2), VII, p. 245, 1896.
Sharp, Fauna Hawaiiensis, II, p. 109, 1900.

Mauna Loa and Kilauea, HAWAII. Collected very abundantly from *Acacia koa* by Perkins and Giffard; bred from the same tree by Swezey at Nauhi, 5,250 feet elevation, Oct., 1931.

Plagithmysus darwinianus Sharp.

Sharp, Ent. Mo. Mag., (2), VII, p. 271, 1896.
Sharp, Fauna Hawaiiensis, II, p. 109, Pl. VI, fig. 16, 1900; F. H., Int., p. lxvii, 1913.

Kilauea, HAWAII. Collected on mamani (*Sophora chrysophylla*) by Perkins and Giffard; ten specimens collected on fallen *Sapindus saponaria* tree, September 28, 1913, by Swezey. Not known to breed in this latter tree.

Plagithmysus sulphurescens Sharp.

Sharp, Ent. Mo. Mag., (2), VII, p. 271, 1896.
Sharp, Fauna Hawaiiensis, II, p. 111, Pl. VI, fig. 17,* 1900.

Kilauea, HAWAII. Collected by Perkins from an unknown tree. Later recorded as breeding in Urera.

Plagithmysus speculifer Sharp.

Sharp, Ent. Mo. Mag., (2), VII, p. 272, 1896.
Sharp, Fauna Hawaiiensis, II, p. 111, 1900.

Iao Valley, MAUI. Collected by Perkins. Host tree not known.

Plagithmysus aestivus Sharp.

Sharp, Ent. Mo. Mag., (2), VII, p. 272, 1896.
Sharp, Fauna Hawaiiensis, II, p. 111, 1900.

MOLOKAI. Collected by Perkins on ohia lehua (*Metrosideros polymorpha*); on the same tree by Giffard at Kalamaula, Molokai.

Plagithmysus funebris Sharp.

Sharp, Ent. Mo. Mag., (2), VII, p. 273, 1896.
Sharp, Fauna Hawaiiensis, II, p. 106, Pl. VI, fig. 10, 1900.

Haleakala, MAUI. Collected by Perkins on *Sophora chrysophylla*; bred from the same tree in 1927 by Swezey; Maui (Koebele); south slope of Haleakala (Forbes).

Plagithmysus aequalis Sharp.

Sharp, Ent. Mo. Mag., (2), VII, p. 273, 1896.
Sharp, Fauna Hawaiiensis, II, p. 112, 1900.

Makaweli, Waimea, Kaholuamano, KAUAI. Collected by Perkins on *Acacia koa*; Kaholuamano (Giffard); Kaholuamano, Waialeale trail, Waialae Falls (Kusche).

* This figure was later designated as *P. giffardi* (Proc. Haw. Ent. Soc., IV, p. 495, 1921).

Plagithmysus arachnipes Sharp.
Sharp, Ent. Mo. Mag., (2), VII, p. 274, 1896.
Sharp, Fauna Hawaiiensis, II, p. 112, Pl. VI, fig. 20, 1900.

KAUAI. Collected on *Acacia koa* by Perkins; Kauai, 4,000 feet (Kusche). Bred from koa at Halemanu by Swezey, July, 1932.

Plagithmysus albertisi Sharp.
Sharp, Ent. Mo. Mag., (2), VIII, p. 12, 1897.
Sharp, Fauna Hawaiiensis, II, p. 110, Pl. VI, fig. 18, 1900.

West Honolulu, OAHU. Collected by Signor d'Albertis, 1874. Host tree not known.

Plagithmysus permundus Sharp.
Sharp, Fauna Hawaiiensis, II, p. 105, 1900.

KAUAI, 2,000 ft. Collected by Perkins on ahakea (*Bobea elatior*).

Plagithmysus diana Sharp.
Sharp, Fauna Hawaiiensis, II, p. 107, Pl. VI, fig. 11, 1900.

KAUAI, 4,000 ft. Collected by Perkins on *Pelea* sp.

Plagithmysus collaris Sharp.
Sharp, Fauna Hawaiiensis, II, p. 107, Pl. VI, fig. 13, 1900.

Haleakala, MAUI. Bred by Perkins from *Pelea* sp.

Plagithmysus lamarckianus Sharp.
Sharp, Fauna Hawaiiensis, II, p. 110, 1900.

Kilauea, HAWAII. Attached to *Pipturus albidus* and *Urera sandwicensis* (Perkins); collected on Pipturus by Giffard; bred from Pipturus at Paauilo, Hawaii, by Williams; bred from Pipturus at Upper Hamakua Ditch trail, Kohala Mts., Hawaii, by Swezey.

Plagithmysus munroi Sharp.
Sharp, Fauna Hawaiiensis, II, p. 112, Pl. VI, fig. 19, 1900.

Waimea, 2,000 ft., KAUAI (Munro). Collected on ohia lehua by Osborn at Kokee, Kauai; Kaholuamano, Waialeale trail, Waialae Falls (Kusche). Collected in pupal cell in *Sideroxylon sandwicense* at Kumuwela by Swezey, June, 1932.

Plagithmysus giffardi Perkins.
Perkins, Proc. Haw. Ent. Soc., I, p. 96, 1907.

Kilauea, HAWAII. Collected on *Suttonia lessertiana* by Perkins and Giffard; bred from *Smilax sandwicensis* by Swezey in 1929.

Plagithmysus fractus Perkins.
Perkins, Fauna Hawaiiensis, III, p. 646, 1910.

MOLOKAI. Fragments collected by Perkins. Host tree not known.

Plagithmysus elegans Sharp.
Sharp, Fauna Hawaiiensis, III, p. 648, 1910.

North Kona, HAWAII (Perkins). Host tree not known

Plagithmysus simplicicollis Sharp.
Sharp, Fauna Hawaiiensis, III, p. 648, 1910.

North Kona, HAWAII (Perkins). Host tree not known.

Plagithmysus kuhnsi Perkins.
Perkins, Proc. Haw. Ent. Soc., III, p. 248, 1916.

Waianae Mts., OAHU (Kuhns). Bred from *Pipturus albidus*, Haleauau Valley, Waianae Mts., Oahu by Swezey, 1927, 1928 and 1932.

Plagithmysus ignotus Perkins.
Perkins, Proc. Haw. Ent. Soc., III, p. 249, 1916.

KAUAI, 3,000 ft. (Munro). Kaholuamano, Kauai (Giffard); Waialae Falls (Kusche). Host tree not known.

Plagithmysus swezeyi Perkins.
Perkins, Proc. Haw. Ent. Soc., IV, p. 344, 1920.

Niulii, HAWAII (Swezey). Host tree not known.

Plagithmysus platydesmae Perkins.
Perkins, Proc. Haw. Ent. Soc., IV, p. 345, 1920.

Glenwood, HAWAII. Bred by Swezey from *Platydesma campanulata*.

Plagithmysus frater Perkins.
Perkins, Proc. Haw. Ent. Soc., IV, p. 500, 1921.

North Kona, HAWAII, 3,000 ft. Collected on *Pelea* sp. by Perkins.

Plagithmysus decorus Perkins.
Perkins, Proc. Haw. Ent. Soc., IV, p. 500, 1921.

Kilauea, HAWAII (Giffard). Host tree not known.

Plagithmysus nihoae Perkins.
Perkins, Tanager Expedition, No. 3, Bull. 31, B. P. Bishop Museum, p. 53, 1926.

NIHOA. Collected on Euphorbia by Bryan.

Plagithmysus forbesii Perkins.
Perkins, Proc. Haw. Ent. Soc., VI, p. 471, 1927.

Alakai Swamp, KAUAI (Forbes). Host tree not known.

Plagithmysus paludis Perkins.
Perkins, Proc. Haw. Ent. Soc., VI, p. 472, 1927.

Alakai Swamp, KAUAI (Forbes). Host tree not known.

Plagithmysus kohalae Perkins.
Perkins, Proc. Haw. Ent. Soc. VI, p. 473, 1927.

Upper Hamakua Ditch trail, Kohala Mts., HAWAII (Swezey). Host tree not known.

Plagithmysus longicollis Perkins.
Perkins, Proc. Haw. Ent. Soc., VI, p. 474, 1927.

Halehaku, MAUI (Bryan). Host tree not known.

Plagithmysus sharpianus Perkins.
Perkins, Proc. Haw. Ent. Soc., VI, p. 475, 1927.

Kumuwela, KAUAI (Swezey). Bred from *Pipturus albidus.*

Plagithmysus molokaiensis Perkins.
Perkins, Proc. Haw. Ent. Soc., VI, p. 475, 1927.

Kamiloloa, 3,200 ft., MOLOKAI (Swezey). Bred from *Pipturus albidus.*

Plagithmysus muiri Perkins.
Perkins, Proc. Haw. Ent. Soc., VI, p. 476, 1927.

Haleauau Valley, Waianae Mts., OAHU (Swezey and Williams). Bred from *Sideroxylon sandwicense.*

Plagithmysus rubi Perkins.
Perkins, Proc. Haw. Ent. Soc., VII, p. 415, 1931.

Olinda, MAUI. Bred from *Rubus hawaiiensis* by Swezey.

Plagithmysus simillimus Perkins.
Perkins, Proc. Haw. Ent. Soc., VII, p. 415, 1931.

Kula Pipe Line trail, Olinda, MAUI. Bred from *Pipturus albidus* by Swezey.

From the above, it will be seen that there are 14 species of Plagithmysus whose host trees have not yet been determined. Twelve of these are uniques, as follows: *newelli, lanaiensis, speculifer, fractus, elegans, ignotus, swezeyi, decorus, forbesii, paludis, kohalae* and *longicollis*; besides all of these, the host tree is unknown for *albertisi* and *simplicicollis*. All of which shows that there is yet much to learn about the Plagithmysus group.

Nesithmysus bridwelli Perkins.
Perkins, Proc. Haw. Ent. Soc., VI, p. 343, 1920.

Mt. Kaala, 3,000 ft., OAHU (Swezey and Bridwell). The two first specimens were collected on ohia lehua and Broussaisia. Bred from *Pelea sandwicensis, Pelea clusiaefolia* and possibly other species of Pelea, on Kaala, 1930; Kahana at summit, 1931; and Waipio Ridge, 1928, by Swezey.

Nesithmysus forbesii Perkins.
Perkins, Proc. Haw. Ent. Soc., IV, p. 503, 1921.

Haipuaena, 3,100 ft., MAUI. Collected on *Pelea* sp. by Forbes. Bred from *Pelea* sp. on the Kula Pipe Line trail, Olinda, Maui, by Swezey, 1927.

Nesithmysus haasii Perkins.
Perkins, Proc. Haw. Ent. Soc., IV, p. 504, 1927.

Wahiawa, 2,000 ft., OAHU (Haas). Bred from *Pelea* sp. at Kahana summit by Swezey, 1931.

Nesithmysus swezeyi Perkins.
Perkins, Proc. Haw. Ent. Soc., VI, p. 485, 1927.

Kula Pipe Line trail, Olinda, MAUI. Bred from *Pelea* sp. by Swezey, 1927.

All of these species of Nesithmysus are detrimental to their host trees. The larvae live in the living tree, either boring down the terminal twigs or branches, or else boring in the heart of living tree trunks and branches.

Aeschrithmysus terryi Perkins.
Perkins, Proc. Haw. Ent. Soc., VII, p. 261, 1929.

Haleakala Crater, MAUI (Degener). Adults and larvae found in stems of silversword (*Argyroxiphium sandwicense macrocephalum*).

Aeschrithmysus swezeyi Perkins.

Perkins, Proc. Haw. Ent. Soc., VII, p. 262, 1929.

Summit of Haleakala, MAUI (Swezey and Whitten). Collected from *Raillardia ciliolata*; larvae also found boring in the stems.

Callithmysus microgaster (Sharp).

Clytarlus microgaster Sharp, Trans. Ent. Soc., London, p. 103, 1879.
Callithmysus microgaster Sharp, Fauna Hawaiiensis, II, p. 113, 1900; III, p. 649, 1910.

Mts. near Honolulu, OAHU (Blackburn); Oahu (Koebele); N. W. Koolau Range and Tantalus (Perkins); Pupukea (Swezey); Waikane (Swezey and Hadden). Collected on *Bobea elatior* and the larvae found in the same tree by Perkins; bred from *Bobea elatior* by Swezey and Hadden, 1930.

Callithmysus microgaster var. (?) **hirtipes** Sharp.

Sharp, Fauna Hawaiiensis, II, p. 113, 1900.

Kaumuahona, OAHU. Collected by Perkins on *Bobea* sp.*; bred from *Perrottetia sandwicensis* in the same locality by Swezey, 1919.

Callithmysus koebelei Perkins.

Perkins, Proc. Haw. Ent. Soc., I, p. 210, fig., 1908.

Tantalus, OAHU. Bred from *Pipturus albidus* by Koebele, Perkins, Swezey and Bridwell; bred from the same tree, Kaipapau valley by Swezey, 1928.

Neoclytarlus modestus (Sharp).

Clytarlus modestus Sharp, Trans. Ent. Soc., London, p. 104, 1879.
Clytarlus modestus Sharp, Fauna Hawaiiensis, II, p. 101, 1900.
Neoclytarlus modestus, Timberlake, Proc. Haw. Ent. Soc., V, p. 17, 1922.

Haleakala, 4,000-5,000 ft., MAUI (Blackburn, Perkins, Giffard, Fullaway, Swezey). Host tree: *Acacia koa*.

Neoclytarlus pennatus (Sharp).

Clytarlus pennatus Sharp, Trans. Ent. Soc., London, p. 532, 1881.
Clytarlus pennatus Sharp, Fauna Hawaiiensis, II, p. 102, Pl. VI, figs. 2, 3, 1900.
Neoclytarlus pennatus, Swezey, Proc. Haw. Ent. Soc., VI, p. 198, 1925.

* Later, Dr. Perkins has stated that this was not a positive identification of the tree from which a single beetle was taken. (Proc. Haw. Ent. Soc., IV, p. 502, 1921).

Haleakala, 5,000 ft., MAUI (Blackburn, Perkins, Giffard, Fullaway, Swezey). Host tree: *Acacia koa.*

Neoclytarlus fragilis (Sharp).

Clytarlus fragilis Sharp, Trans. Ent. Soc., London, p. 534, 1881.
Clytarlus fragilis Sharp, Fauna Hawaiiensis, II, p. 99, 1900.
Neoclytarlus fragilis, Bridwell, Proc. Haw. Ent. Soc., IV, p. 323, 1920.

Palolo Valley, OAHU (Blackburn, Perkins); Waianae Mts., Tantalus (Perkins); Fort Shafter Ridge (Swezey). Host tree: *Acacia koa.*

Neoclytarlus filipes (Sharp).

Clytarlus filipes Sharp, Trans. Dublin Soc., (2), III, p. 196, 1885.
Clytarlus filipes Sharp, Fauna Hawaiiensis, II, p. 99, 1900.
Neoclytarlus filipes, Perkins, Proc. Haw. Ent. Soc., VII, p. 382, 1931.

Mauna Loa, HAWAII (Blackburn)); Kona, Kau, Kilauea (Perkins); Huehue (Swezey). Attached to *Sophora chrysophylla.* Reared from *Maba sandwicensis* at Puuwaawaa Ranch, Hawaii, August, 1929 (Williams).

Neoclytarlus mediocris (Sharp).

Clytarlus mediocris Sharp, Fauna Hawaiiensis, II, p. 99, Pl. VI, figs. 1, 1b, 1900.
Neoclytarlus mediocris, Perkins, Proc. Haw. Ent. Soc., VI, p. 485, 1927.

Haleakala, 3,000-5,000 ft., MAUI (Perkins). Attached to *Sophora chrysophylla.*

Neoclytarlus debilis (Sharp).

Clytarlus debilis Sharp, Fauna Hawaiiensis, II, p. 99, 1900.
Neoclytarlus debilis, Swezey, Proc. Haw. Ent. Soc., VI, p. 198, 1925.

Mauna Loa, 4,000 ft., Hualalai, 5,000 ft., HAWAII (Perkins); South Kona (Swezey). Host tree: *Acacia koa.*

Neoclytarlus obscurus (Sharp).

Clytarlus obscurus Sharp, Fauna Hawaiiensis, II, p. 100, 1900.
Neoclytarlus obscurus, Perkins, Proc. Haw. Ent. Soc., VI, p. 485, 1927.

Various localities, 3,000 ft., KAUAI (Perkins); Kaholuamano (Kusche). Host tree: *Acacia koa.*

Neoclytarlus claviger (Sharp).

Clytarlus claviger Sharp, Fauna Hawaiiensis, II, p. 101, 1900.
Neoclytarlus claviger, Swezey, Proc. Haw. Ent. Soc., VI, p. 198, 1925.

Kilauea, HAWAII (Perkins). Host tree: *Acacia koa.*

Neoclytarlus laticollis (Sharp)

Clytarlus laticollis Sharp, Fauna Hawaiiensis, II, p. 101, 1900.
Neoclytarlus laticollis, Swezey, Proc. Haw. Ent. Soc., VI, p. 198, 1925.

Haleakala, 5,000 ft., MAUI (Perkins). Host tree: *Acacia koa.*

Neoclytarlus abnormis (Sharp).

Clytarlus abnormis Sharp, Fauna Hawaiiensis, II, p. 102, 1900.
Neoclytarlus abnormis, Perkins, Proc. Haw. Ent. Soc., VI, p. 481, 1927.

Olaa, HAWAII (Perkins). Probably attached to Metrosideros or Straussia.

Neoclytarlus nodifer (Sharp).

Clytarlus nodifer Sharp, Fauna Hawaiiensis, II, p. 102, 1900.
Neoclytarlus nodifer, Perkins, Proc. Haw. Ent. Soc., VI, p. 485, 1927.

Kona, 3,000 ft., HAWAII (Perkins); Puuwaawaa (Giffard); Humuula (Meinecke); Judd Trail, Kona (Swezey). Host tree: *Acacia koa.*

Neoclytarlus longipes (Sharp)

Clytarlus longipes Sharp, Fauna Hawaiiensis, II, p. 103, Pl. VI, fig. 4, 1900.
Neoclytarlus longipes, Swezey, Proc. Haw. Ent. Soc., VI, p. 198, 1925.

KAUAI (Perkins); Kaholuamano (Kusche). Host tree: *Acacia koa.* Bred from *Alphitonia excelsa* at Halemanu by Swezey, June, 1932.

Neoclytarlus annectens (Sharp).

Clytarlus annectens Sharp, Fauna Hawaiiensis, II, p. 104, 1900.
Neoclytarlus annectens, Swezey, Proc. Haw. Ent. Soc., VI, p. 198, 1925.

KAUAI (Perkins); 3,500-4,000 ft., Kauai (Kusche). Host tree: *Acacia koa.*

Neoclytarlus ultimus (Sharp).

Clytarlus ultimus Sharp, Fauna Hawaiiensis, III, p. 645, 1910.
Neoclytarlus ultimus, Perkins, Proc. Haw. Ent. Soc., VI, p. 485, 1927.

Tantalus, Pauoa, OAHU (Koebele, Perkins). Host tree: *Acacia koa.*

Neoclytarlus immundus (Sharp).

Plagithmysus immundus Sharp, Fauna Hawaiiensis, III, p. 646, 1910.
Neoclytarlus immundus, Perkins, (in letter, Jan. 9, 1927), Proc. Haw. Ent. Soc., VII, p. 16, 1928.

North Kona, HAWAII (Perkins, Giffard). Host tree not known.

Neoclytarlus indecens (Perkins).
Clytarlus indecens Perkins, Proc. Haw. Ent. Soc., IV, p. 346, 1920.
Neoclytarlus indecens, Bridwell, Proc. Haw. Ent. Soc., IV, p. 454, 1921.

Mt. Kaala, OAHU, September 7, 1913 (Osborn). Bred from *Smilax sandwicensis,* Mt. Kaala, July 9, 1916 (Swezey); Kaala, 1919, 1920 (Bridwell); Kahana, 1927, Waipio Ridge, 1929 (Swezey).

Neoclytarlus indecens var. kinaluensis Perkins.
Perkins, Proc. Haw. Ent. Soc., VII, p. 418, 1931.

Kainalu, 2,000 ft., MOLOKAI. Bred by Swezey from *Smilax sandwicensis.*

Neoclytarlus euphorbiae Bridwell.
Bridwell, Proc. Haw. Ent. Soc., IV, p. 323, 1920.

Ewa Coral Plain, OAHU (Bridwell, Swezey, Bryan). A large series bred from stems of *Euphorbia multiformis.*

Neoclytarlus pulchrior Perkins.
Perkins, Proc. Haw. Ent. Soc., VI, p. 482, 1927.

A single specimen known. It was found unlabelled among some miscellaneous specimens; hence, collector, locality and host plant are not known.

Neoclytarlus fugitivus Perkins.
Perkins, Proc. Haw. Ent. Soc., VI, p. 483, 1927.

Haleakala, 4,500 ft., MAUI. One specimen collected January 14, 1926, along the Kula Pipe Line trail by Swezey. Host plant not known.

Neoclytarlus smilacis Perkins.
Perkins, Proc. Haw. Ent. Soc., VI, p. 484, 1927.

Waikamoi, 4,500 ft., MAUI. Bred by Swezey from larvae in stems of *Smilax sandwicensis,* Jan., Feb., 1926.

Neoclytarlus raillardiae Perkins.
Perkins, Proc. Haw. Ent. Soc., VII, p. 416, 1931.

Summit of Haleakala, MAUI. A dozen collected by Swezey, June 17, 1927, from clumps of half-dead *Raillardia ciliolata* bushes, and larvae also found in dead stems.

Neoclytarlus geranii Perkins.
Perkins, Proc. Haw. Ent. Soc., VII, p. 417, 1931.

Haleakala, 6,000 ft., MAUI. Beetles collected by Swezey, June 15, 1927, from clumps of *Geranium trifida,* and larval burrows and exit holes found in dead stems.

Paraclytarlus timberlakei Perkins.
Perkins, Proc. Haw. Ent. Soc., VI, p. 480, 1927.

Mt. Olympus, OAHU. A single specimen collected on ohia lehua by Timberlake in 1916.

Paraclytarlus pipturicola Perkins.
Perkins, Proc. Haw. Ent. Soc., VI, p. 481, 1927.

Kailua, MAUI. A single specimen collected June 14, 1920, by Bryan on *Pipturus albidus.*

Paraclytarlus podagricus Perkins.
Perkins, Proc. Haw. Ent. Soc., VI, p. 482, 1927.

Upper Hamakua Ditch trail, Kohala Mts., HAWAII. A single specimen collected by Swezey September 2, 1919. Host tree not known.

FREDERICK A. G. MUIR

Biographical Sketch
The Work of Dr. Frederick A. G. Muir in the Biological Control of Sugar Cane Insects in Hawaii

BY O. H. SWEZEY AND F. X. WILLIAMS

(Presented at the meeting of June 4, 1931)

With the death of Dr. Muir in England on May 13, 1931, ended the career of a man who had devoted his best years to the field of biological control as a method of controlling insect pests. Dr. Muir began this work for the Experiment Station of the Hawaiian Sugar Planters' Association in September, 1905. This was when the sugar cane leafhopper (*Perkinsiella saccharicida* Kirk.) was still a serious pest in Hawaii. It was also shortly after the introduction of the leafhopper egg-parasites* by Albert Koebele and Dr. R. C. L. Perkins, from Australia and Fiji. These parasites had not yet shown their ability to cope with the enormous numbers of their host. Mr. Koebele had been working for more than ten years on the introduction of beneficial insects into Hawaii and, being in failing health, wished to retire from active foreign work in the tropics. On his return from Fiji he spent but a short time in Honolulu in the summer of 1905, before leaving for California. Mr. Koebele never came to Honolulu again.

To carry on the work in which Mr. Koebele had been so successful since his arrival in Hawaii in 1893, Dr. Muir was engaged, and his services on the staff of the Experiment Station, H.S.P.A., commenced September 1, 1905.

Spending but a short time in Honolulu, Dr. Muir's first foreign trip was to Fiji with the primary object of investigating the economic conditions of the leafhopper in cane fields there. This leafhopper was a different species from the cane leafhopper in Hawaii and was found doing no damage to cane, being kept in check by several natural enemies, the most important of which were the egg-parasites mentioned above and which had already been introduced into Hawaii. Another parasite found to have economic value was a stylopid (*Elenchus tenuicornis* Perk.). Attempts were made to introduce this parasite into Hawaii, but it

* *Paranagrus optabilis* Perk., *P. perforator* Perk., and *Anagrus frequens* Perk., from Australia in 1904; and *Ootetrastichus beatus* Perk. from Fiji in 1905.

failed to attack the leafhopper in the cane fields there. Still another parasite found was a dryinid (*Haplogonatopus vitiensis* Perk.) which was successfully introduced into Hawaiian cane fields, and for a time was quite a factor in the control of the leafhopper. After a number of years, however, it became scarce and in recent years has been seldom seen.

On this trip a great deal of time was spent in investigating the cane borer (*Rhabdocnemis obscura* [Boisd.]) to discover if possible the cause of its decrease there, for Mr. Koebele had reported such a decrease in Fiji since his visit there in 1892. No natural enemies were found that could be considered responsible for this. Some of the planters believed that the introduction of a harder variety of cane was the chief reason for the decrease of the borer. After six months in Fiji, Dr. Muir returned to Honolulu, where a few months were spent prior to starting off in July, 1906, for the Orient, where cane leafhopper parasites were investigated in south China in the vicinity of Macao, and inland from Canton. Cane leafhoppers there were found well controlled by egg-parasites similar to those in Australia and Fiji, and there were other valuable enemies as well. Only one of these was successfully introduced into Hawaii. This was a large black dryinid (*Pseudogonatopus hospes* Perk.), parasitic on adult leafhoppers. It was reared at the Experiment Station and colonies were distributed to the other islands, but it was only after nine years that it was known to have become established in Hawaiian cane fields. It never became very numerous, but even in recent years with the leafhopper usually scarce, this parasite maintains its existence, and an occasional parasitized leafhopper is to be found usually wherever any leafhoppers occur.

In February a brief visit was made to the Federated Malay States where conditions as regards leafhoppers and their enemies were found to be about as in China. A search was begun for the cane borer beetle, which was continued in Java; Dr. Muir arrived at Batavia on March 10th and spent several months in the different sugar cane sections of Java, without finding any evidence of our cane borer beetle, or any direct parasites on related beetles in banana and palm trees.

On July 21, he left Java for a few weeks' search for the borer in Borneo, returning to Batavia in September, from which place

another start was made in October, 1907. The search for the natural home of the beetle borer was continued in Amboina and Larat, where at last this insect was found in sago and pinang palms and in sugar cane. No success was had in finding parasites for several months, however. Finally, in January, 1908, a tachinid fly* was found attacking the grubs or larvae of this borer. Eight months were then spent at Amboina in studying this parasite and breeding it for shipment to Honolulu; but as the parasite could not survive such a long journey, attempts were made to establish a relay station at Hongkong. This station, which was to have been conducted by F. W. Terry, was not successful as the tachinids always died en route. Finally, Dr. Muir tried taking living material with him to Hongkong, but the flies all died the day before his arrival. This venture having failed, Dr. Muir left Hongkong in November, 1908, for further explorations, visiting Ceram and Makassar, en route to New Guinea, where he landed at Port Moresby in April, 1909. Here for the first time, the tachinid parasite, that was breeding so well on the borer grubs in palm trees at Amboina, was found attacking a high percentage of the borer grubs in sugar cane. At once preparations were made for stocking cages with borer-infested cane in which the borers were to be parasitized, and then brought to Honolulu. Several months were required for this, and when eventually the cages were in readiness for the long journey, Dr. Muir fell ill with typhoid fever just prior to leaving Port Moresby, New Guinea, so that on arriving at Brisbane, Queensland, he was compelled to go to a hospital where he remained for five weeks. His cages were forwarded to Honolulu, arriving there September 15, 1909. Over 200 of the tachinid flies had matured en route, but, lacking the personal care that had been planned for them, all had died before their arrival in Honolulu. Thus is recorded another failure in the introduction of this parasite.

As soon as he had recovered sufficiently in the Brisbane hospital, Dr. Muir came on to Honolulu for further recuperation, arriving about the end of October, after an absence from Honolulu of three years and three months, most of which time was spent in tropical jungles where he was exposed to the dangers from wild animals, venomous snakes and insects, as well as to tropical diseases prevalent in those regions.

Ceromasia sphenophori Vill.

At once plans were made for further attempts to introduce this parasite on the cane borer. Dr. Muir left Honolulu, January 8, 1910, on the final endeavor which resulted in the transportation of the living parasite to Honolulu and its establishment in the cane fields of Hawaii. The procedure this time was the establishing of a relay breeding station at Mossman, Queensland, cared for by Mr. J. C. Kershaw. In cages here the tachinid was bred from material brought by Dr. Muir from New Guinea. Of the first generation of parasites reared in these cages, a portion was taken in the puparium stage to Fiji, where at Nausori another relay breeding station was established. From the next generation of parasites produced here, living material was brought to Honolulu by Dr. Muir on August 16, 1910. Mr. Kershaw arrived a month later with more material reared in Fiji. From both of these lots there were sufficient adult parasites to allow some to be liberated in a few cane fields, while others were retained for breeding in cages. Altogether, over four years were occupied on this project; from the beginning until living parasites were landed in Honolulu. The results obtained in checking the cane borer after the parasite was established and fully distributed, more than justified the time, effort and expense involved.

Staying a short time, until the breeding of the tachinid was well started, Dr. Muir sailed from Honolulu, October 4, 1910, for a well-earned leave, going to England for a year, and returning to Honolulu, October 11, 1911.

The next large project undertaken by Dr. Muir, was the endeavor to find and introduce natural enemies of the cane root grub, *Anomala orientalis* (Waterhouse), which in 1912 was found established in cane fields in the Pearl Harbor district of Oahu. There was little or no encouragement to be had from previous efforts to control root grubs by natural enemies in other parts of the world. However, after duly considering the situation, Dr. Muir believed that an attempt should be made to control the spread of Anomala in our cane fields by this method. He left Honolulu for Japan, March 28, 1913, that country being the home of *Anomala orientalis*. A number of valuable natural enemies were found working on Anomala there and efforts were made to introduce some of them here, but none ever became established. After about a year in Japan, search was made in Java, Formosa

and the Philippines for parasites of closely related species of root grubs that might possibly be utilized against Anomala. The breaking out of the World War disturbed transportation from those regions, and it was found that the Philippines were the most favorable place in which to work and to secure dependable transportation for consignments of parasites. A large number of root-grub enemies were studied in the Philippines, headquarters being established at the College of Agriculture at Los Banos, where every facility for the work was rendered. Dr. Muir was assisted in the work here by Mr. H. T. Osborn and Dr. F. X. Williams, and large quantities of some of the parasites were reared for shipment to Honolulu, and many consignments were made during 1915, 1916 and 1917.

Of the numerous parasites of several kinds that were handled, *Scolia manilae* Ashmead, the wasp which parasitizes the Anomala grub was the only one to become established in our cane fields. It was first found established and breeding on Anomala grubs September 16, 1916. In the four years since its discovery, Anomala had spread over a considerable area of cane land adjacent to Pearl Harbor. As soon as Scolia was found established in one field, assistance was given it in spreading throughout the Anomala-infested area. This was accomplished during the next year, and the wasp proved so efficient that attempts to introduce additional parasites on Anomala were discontinued. This project turned out to be the first successful control of a root grub by means of natural enemies.

During the four years involved in this work, Dr. Muir returned to Honolulu once or twice; on one trip, coming via Formosa, he brought some leafhopper egg-parasites, one of which (*Ootetrastichus formosanus* Timberlake) became established and spread throughout the cane fields of the islands and was an additional factor in the control of the sugar cane leafhopper. It persists to the present time, even where the leafhopper is normally scarce.

On October 31, 1917, Dr. Muir left for England to engage in war service for his native country in the trying days of the World War. He returned to Honolulu a year later on October 28, 1918. In the meantime he had married Margaret Annie Sharp on April 9, 1918, the daughter of Dr. David Sharp, the noted entomologist

who contributed much to the study of Hawaiian insects and to the Fauna Hawaiiensis. Mrs. Muir accompanied Dr. Muir on his return from England, and also on his last trip in search of parasites to Australia, which was begun early the next year.

Although there now existed a fairly satisfactory control of the sugar cane leafhopper by the introduced parasites previously mentioned, nevertheless in a few plantations there were recurrences of leafhopper outbreaks which were of considerable importance. The purpose of Dr. Muir's last trip May 18, 1919, to June 21, 1920, was to endeavor to find what additional factors controlled the leafhopper in the Queensland cane fields. After considerable research, he found that a small bug, *Cyrtorhinus mundulus* (Breddin), of the family Miridae, lived by sucking the contents of the eggs of the leafhopper. The introduction of this bug into Hawaii was soon accomplished, chiefly from Fiji (where it was known to occur), by Mr. C. E. Pemberton the following year, September to November, 1920. This bug was reared and colonies distributed for a year, and from thereafter when it became thoroughly established, the control of the leafhopper pest in Hawaiian cane fields was practically complete. There have been slight outbreaks occasionally, but the Cyrtorhinus bug was always prompt to find them, and would soon increase to numbers sufficient to regain control. It has been thought that if this bug had been the only leafhopper enemy introduced it might of itself have been able to sufficiently control the leafhopper.

The total results of the major introductions above enumerated have been the saving of millions of dollars to the sugar industry in Hawaii, and the comparative freedom from destructive insect pests in the cane fields.

After returning from the last trip to Australia, Dr. Muir established his home in Honolulu. Much of his time was now devoted to systematic studies in Homoptera, particularly the Fulgoroidea. This is the group which contains the family Delphacidae to which the cane leafhopper belongs. In his travels Dr. Muir made a specialty of studying and collecting sugar cane leafhoppers as well as other related leafhoppers. Many species of these were named and described by him in numerous papers included in the bibliography which follows. He became intensely interested also in the leafhoppers of the forests of Hawaii, and

added many species to those already known, these new species of the Hawaiian fauna being published in the Proceedings of the Hawaiian Entomological Society. Dr. Muir eventually devoted himself to the study of leafhoppers the world over, and was recognized as a world authority on the leafhoppers of the family Delphacidae. Just before his death he was planning to work up a large collection from South America.

Dr. Muir's health had been undermined by so much time spent in unhealthful tropical jungles, etc., and he went to England at intervals, spending most of the years 1927 and 1928 there. On his return from England, September 12, 1928, arrangements were made for his retirement from active service at the Experiment Station, H.S.P.A. He left Honolulu on November 17, 1928, to make his home in England, and had made preparations for carrying on systematic work there in his favorite family of leafhoppers, which work, however, he was not able to pursue because of his failing health.

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1915. The relation of the parasite to its host. XIII, pp. 118-125, 1 diagram.
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Three New Parasitic Hymenoptera from the Indo-Malayan Region

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(Presented by O. H. Swezey at the meeting of December 3, 1931)

The three hymenopterous parasites described herewith were discovered by Messrs. Pemberton and Hadden during their explorations for enemies of the insect pests of sugar cane for importation to the Hawaiian Islands. The types are deposited in the collection of the Hawaiian Sugar Planters' Experiment Station, and paratypes in the collection of the author and of the U. S. National Museum.

Family SCELIONIDAE

Scelio serdangensis n. sp.

♀.—Black, the scape, mandibles and legs, including coxae, rufo-testaceous. Tegulae dark castaneous to rufo-testaceous. Wings moderately smoky, much clearer along the anterior margin from the base to a little beyond the end of venation, and with the usual longitudinal hyaline streak just below the middle of disk. Venation testaceous. Head and mesonotum coarsely reticulato-punctate. Lower part of face between each eye and antennal prominence with about four short carinae converging toward mouth. Genal carina twofold, the components hardly spreading apart except close to the eye. Cheeks coarsely reticulato-punctate. Vertex behind ocelli dullish, finely and confluently punctured in the middle and becoming coarsely reticulato-punctate at the sides. Smooth area above antennal prominence reaching about one-third of distance to anterior ocellus, or it may be said to extend a little more than half way, with its upper portion more or less disfigured by transverse carinae. Lateral ocelli about equalling the anterior ocellus in size and almost or quite touching the eye margins. Thorax in lateral aspect nearly twice as long as high, with the propodeum very weakly declivous. Side pieces of pronotum, mesoscutum, and scutellum very coarsely reticulato-punctate, the separating carinae on the mesonotum tending to form prominent longitudinal lines. Apical margin of scutellum smooth and shining. Metanotum very short, having in the middle a vertically declivous surface with a slightly protruding lip above, its vertical surface finely and closely longitudinally striate. Lateral portions of metanotum smooth and polished, each with about seven or eight very deep, round punctures equally spaced in a row. Abdomen moderately broadly fusiform, with the third segment rather less than twice as broad as long. First tergite nearly twice as broad at apex as it is long in the median line. Second tergite deeply impressed across the base. Tergites 1 to 5 longitudinally striate, the striae

leaving a smooth transverse strip on apical margin of tergite 2 and a similar area on the middle of apical margin of tergite 3. Tergite 3 longest, 4 only slightly shorter, and 2 and 5 about three-fourths as long as 3. Antennal scape nearly reaching level of anterior ocellus. Pedicel nearly twice as long as thick. Flagellum moderately stoutly fusiform. Joint 1 of flagellum somewhat longer than the pedicel. Joints 2 to 9 more or less transverse. Joints 2 to 4 distinctly longer beneath than on dorsal side, and 5 slightly longer beneath than above. Joints 2 and 3 subequal, together about equalling 1. Joint 4 on the under side somewhat shorter than 5, and much shorter than 5 on the dorsal side. Joint 5 distinctly longer than the following joint, but not equalling 6+7, nor as long as 1. Joints 6 to 9 subequal in length, 10 slightly longer and pointed at apex but hardly longer than thick. Pubescence of body consisting of coarse, stiff, somewhat flattened setae, silvery white and conspicuous on the head and anterior part of thorax, and somewhat finer, more appressed and less conspicuous on sides of abdomen. Sides of propodeum with very dense, fine, appressed, white pubescence.

Length, 3.4 to 3.8 mm.

♂.—Similar to the female. Antennae piceous, the scape somewhat rufotestaceous toward base. Legs as in female. Wings clouded only on the apical third. Sculpture similar except that the vertex behind ocelli to the occipital carina is coarsely reticulato-punctate like the frons. Scape shorter than in female, reaching about two-thirds of the distance to anterior ocellus. Pedicel, disregarding the short stalk at base, hardly longer than thick. Joint 1 of flagellum nearly twice as long as thick and about one-third longer than pedicel. Joint 2 about as long as thick and somewhat thicker than 1. Joint 3 much the largest and broadest joint of flagellum and about as long as thick. Joints 4 to 7 each about as long as thick, very similar in shape, but decreasing slightly in size successively toward apex. Joint 8 nearly twice as long as thick and pointed at apex. Pubescence of body fine and considerably less conspicuous than in female.

Length, 3.1 to 3.6 mm.

Described from 14 females, 7 males (holotype ♀, allotype and paratypes) reared from eggs of *Oxya chinensis* (Thunb.) at Serdang, Selangor, Federated Malay States, in October and December, 1930 (C. E. Pemberton).

In Kieffer's key to the species of the Indo-Malayan region (Das Tierreich, 48, p. 309), this species agrees best with *S. consobrinus* Kieffer, from which the female differs in having the lateral ocelli slightly larger and closer to the eye margin, the occiput dullish and much more finely sculptured, and the reticulations of mesonotum forming more definite longitudinal carinae. The male differs from the same sex of *consobrinus* in having more definite converging striae on the lower part of the face, the reticulations of vertex considerably coarser, not becoming finer just above the occipital carina as in *consobrinus*, and the wings clearer

at base and with a rather abruptly bounded pale fuscous cloud on the apical third of disk. In *consobrinus* the cloud has a more yellowish or brownish tint and occupies the apical half but is very indefinitely bounded.

In Dodd's key to the Australian species (Proc. Roy. Soc. Queensland, 38, p. 131-134), *serdangensis* runs to *S. bipartitus* Kieffer from which the female differs in having the first tergite distinctly transverse, the vertex with a finely rugose area behind ocelli, the lateral ocelli closer to the eye margins, the sculpture of mesonotum much coarser and much more distinctly reticulate, etc.

Scelio pembertoni n. sp.

♀.—Black, the basal half of scape, mandibles and tegulae rufo-testaceous. Legs yellowish testaceous, with hind tibiae more brownish and the tarsi somewhat fuscous. Wings moderately smoky, with the usual longitudinal hyaline streak on the middle of disk. Venation fuscous, with the submarginal vein dark brown. Head rather coarsely and closely foveately punctate, but not at all reticulately sculptured. Lower part of face between each eye and antennal prominence with about four short carinae converging toward mouth. Genal carina simple, but joining with a transverse carina on anterior part of cheeks. Ocellar region of vertex with an impunctate transverse space. Area between ocelli and occipital carina deeply punctured like the frons and cheeks. Smooth area above antennal prominence reaching about half way to the anterior ocellus. Lateral ocelli oval, larger than the anterior ocellus and well separated from the eye margins. Scape reaching nearly to the anterior ocellus. Pedicel about thrice as long as thick. Flagellum slenderly fusiform. Joint 1 of flagellum somewhat longer than pedicel. Joints 2 and 3 hardly shorter above than beneath, 2 being slightly longer than thick, and 3 slightly broader than long. Joint 4 distinctly shorter above than beneath and distinctly broader than long. Joint 5 much longer than the preceding or following joint, subquadrate and somewhat broader than long. Joints 6 to 9 subequal in length but decreasing successively in width toward apex, 6 being distinctly transverse and 9 only slightly wider than long. Joint 10 somewhat longer than thick and conically pointed. Thorax in lateral aspect rather less than twice as long as high, with the propodeum very weakly declivous. Dorsal surface of pronotum, the mesoscutum and scutellum foveately punctate like the head. Scutellum with a small projecting tooth on each side. Metanotum distinctly longer than in *serdangensis*. The median part somewhat protruding and rather finely and densely rugose. The lateral parts with a row of about eight punctures along the posterior margin and finely wrinkled in front of the punctures. Propodeum rather coarsely rugose, with about six short longitudinal carinae at the base. Abdomen somewhat narrowly fusiform. Tergite 1 transverse, about twice as broad at apex as the median length. Tergite 2 somewhat broader than long and shorter than 3. The latter about one and one-third times broader than long. Tergite 4 about equal to 2, except that it is a little broader. Tergite 5 about two-thirds as long as 4 and about one and one-fourth times broader at base than long. Tergite 2 slightly depressed at base. Tergites

1 to 5 longitudinally striate, 2 being also rather distinctly reticulate on basal half. The striae on 1 to 3 somewhat irregular, branching or anastomosing, but not so markedly so as in *S. philippinensis* Ashmead. Tergite 2 with a smooth narrow band on apical margin. Tergites 2 and 3 with a similar but less evident smooth strip that is more or less triangularly inclined at middle. Pubescence fine, pale colored but inconspicuous, a single hair arising from each one of the large punctures on head and thorax. The hair on the dorsal surface of thorax is much more abundant than in *serdangensis* but is not easily seen except in profile view.

Length, 3.5 to 4.0 mm.

♂.—Similar to the female. Coloration the same, with the apical fifth of scape and the flagellum very dark brown or fuscous, becoming slightly more reddish beneath. Wings as deeply colored throughout as in the female. Sculpture practically the same throughout as in female. Scape much shorter, reaching about halfway to the anterior ocellus. Pedicel about twice as long as thick and thickest a little before the apex. Joint 1 of flagellum about three times as long as thick and distinctly longer than the pedicel or the following joints. Joints 2 to 7 about equal in length, with joint 3 distinctly thicker than the preceding or following joints, but not conspicuously enlarged as in *serdangensis*. Joints 4 to 7 decreasing only slightly in thickness distad. Joint 8 about twice as long as thick and conically tapering on the apical half. Pubescence as in the female.

Length, 3.1 to 4.25 mm.

Described from 14 females, 7 males (holotype ♀, allotype and paratypes) reared from eggs of *Oxya chinensis* (Thunb.) at Serdang, Selangor, Federated Malay States, in December, 1930 (C. E. Pemberton).

In Dodd's key to the Australian species, this runs to *S. punctaticeps* Dodd, which differs from *pembertoni* in having the basal third of wings pale, tergites 1 to 5 striate, without reticulations on 2, punctures of frons much smaller and not confluent, scutellum without a projecting tooth on each side, second tergite deeply impressed at base, etc.

In Kieffer's key to the Indo-Malayan species, *pembertoni* runs to *S. xanthopterus* Kieffer, but actually agrees better with *S. philippinensis* Ashmead. In all three species the parapsidal lines of the mesoscutum are about equally obscure and better observed at low magnification. The three species may be separated as follows:

1. Wings clouded with more or less dilute fuscous; scape testaceous yellow or rufo-testaceous, with the apex more or less fuscous; scutellum with a little projecting tooth on each side..... 2

   Wings distinctly yellowish; scape and basal half of flagellum testaceous yellow; scutellum without a projecting tooth on each side, length, about 4.8 mm.....*xanthopterus* Kieff.

2. Tergites 1 to 3 punctate-striate, with the striae on 1 and 2 irregular and more or less anastomosing; length about 3.5 mm.....*philippinensis* Ashm.

Tergite 2 somewhat punctate on basal half, the striae only slightly anastomosing; tergites 1 and 3 merely striate, with the striae rather regular; scape considerably darker at apex and wings more strongly clouded than in preceding species; length 3.5 to 4.0 mm.....*pembertoni* Timb.

The two new species described above are closely allied with two species from Coimbatore, India, named in manuscript by Girault. At least one of these (*oxyae*) has been mentioned in the Indian literature with a few descriptive words, but in no way recognizably described. Mr. Girault named these during his residence at Washington, D. C., but evidently did not complete his study of them before returning to Australia, as he has not published any description as far as known. With apologies to Mr. Girault, therefore, some of the distinguishing characters of his new species are presented in the following table, leaving the question of authorship to some future reviser. The types were deposited by Mr. Girault in the U. S. National Museum.

Table of four Indo-Malayan species of Scelio

1. Lateral ocelli practically touching eye-margin; sculpture of mesonotum coarsely reticulato-punctate; second tergite transversely impressed at base; pubescence coarse, silvery white and conspicuous..... 2

Lateral ocelli well separated from eye margin; mesonotum with shallowly impressed punctures, not at all reticulate; second tergite less distinctly or less abruptly transversely impressed at base; pubescence fine and inconspicuous 3

2. Sides of face between eye and antennal prominence with about four coarse rather long carinae converging toward mouth; genal carina compound, i.e., composed of three carinae lying very close together, but spreading slightly on approach to eye, the outer one branching twice on to the cheek; frons very coarsely reticulato-punctate like the mesonotum; middle of vertex above occipital carina shining, with small punctures set in coarse reticulations similar to those of frons; black, the mandibles, scape, pedicel and legs, except coxae, rufo-testaceous; length about 4.5 mm. (Coimbatore, India, from eggs of Hieroglyphus).....
.....*hieroglyphi* (Girault) n. sp.

Sides of face with similar but much shorter and less conspicuous carinae; genal carina twofold, the components hardly spreading apart on approach to eyes; reticulations of cheek abutting against the genal carina, vertex between ocelli and occipital carina dullish, finely sculptured and punctured, with hardly a trace of coarse reticulations; frons rather less deeply and less coarsely reticulate than the mesonotum; coloration as in *hieroglyphi*, but coxae pale and pedicel piceous or blackish; length, about 3.1 to 3.8 mm.....*serdangensis* Timb.

3. Scutellum unarmed; first tergite of abdomen distinctly longer than wide at base and about as long as the apical width, its surface striato-punctate; second tergite rather strongly impressed on basal half, longitudinally striate except for a smooth area in the middle half of apical margin, the striae more or less irregular and anastomosing toward base of segment; head moderately coarsely and subreticulately punctured; flagellum rather slenderly fusiform; black, the legs, mandibles, scape and pedicel rufo-testaceous, with the femora slightly infuscated at apex, veins of wings testaceous, the marginal vein somewhat infuscated; length, about 3.9 mm. (Coimbatore, India, from eggs of Oxya).....*oxyae* (Girault) n. sp.

Scutellum with a small projecting tooth on each side; first tergite of abdomen transverse, distinctly shorter than the basal width, its surface coarsely striate and not at all punctate; second tergite hardly impressed at base, rather closely striate except in a narrow strip on apical margin, and the basal half somewhat striato-punctate; sculpture of head and mesonotum coarser than in *oxyae*, with the interspaces between the foveate punctures distinctly less carina-like on the head than in *oxyae*; mandibles, legs and basal half of scape testaceous or rufo-testaceous, with the apex of scape strongly infuscated and the pedicel piceous or blackish; veins of wings rather dark brown, the submarginal a little paler; length, 3.1 to 4.25 mm.....*pembertoni* Timb.

Family ENCYRTIDAE

The new species of Anagyrus described below belongs in a group of species having the flagellum white except the first funicle joint which is black or partly black. To this category belong *A. pseudococci* (Girault), *A. subalbicornis* (Girault), *A. dactylopii* (Howard), *A. yuccae* (Coquillett), *A. subalbipes* Ishii, *A. sawadai* Ishii, *A. greeni* Howard, and *A. aurantifrons* Compere. *A. bohemani* as identified by certain authors would also belong here, but Westwood in the original description cites only the *"articulis ultimis albis."* The new species differs from all of these especially in its unusually depressed form. It may be distinguished from three of the most similar Old World species as follows:

Females

1. Ovipositor not obviously protruded..... 2

Ovipositor shortly but distinctly protruded, the sheaths broad; hypopygium prominent and extending shortly beyond apex of the last tergite; frontovertex broader than long; clypeal margin with a deep rounded emargination; abdomen slightly longer than thorax (Ceylon)..... *greeni* Howard

2. Eyes evidently hairy, the pile comparatively dense and long..... 3

Eyes almost bare, although an extremely fine, short pile may be distinguished under high magnification; pedicel distinctly longer than the

first funicle joint, which is about twice as long as thick and subequal to each of the next three joints; marginal vein hardly longer than wide, the postmarginal a little shorter than marginal; head and thorax orange yellow with a golden luster. (Hongkong, China, parasitic on *Pseudococcus filamentosus*) ..... *dactylopii* (Howard)

3. Form ordinary, the abdomen about as long as head and thorax combined; marginal vein about as long as wide; the postmarginal vestigial; pedicel slightly longer than the first funicle joint, the latter slightly longer than the following joint, head and thorax orange yellow, with the mesonotum often more or less dusky, or even almost entirely black. (Sicily, parasitic on *Pseudococcus citri*) ..... *pseudococci* (Girault)

Form evidently depressed, the abdomen distinctly longer than the head and thorax combined; marginal vein about twice as long as wide, the postmarginal hardly shorter than marginal; pedicel distinctly longer than the first funicle joint, which also is distinctly longer than the following joint; scape only moderately expanded, with the outer face distinctly grooved between the thickened dorsal margin and the ventral expansion; head and thorax bright orange yellow ..... *saccharicola*, n. sp.

Males.

1. Head entirely black, the face and cheeks with conspicuous white appressed pubescence 2

Face more or less brown or orange brown 3

2. Pro- and mesopleura entirely orange-brown; eyes almost bare ..... *dactylopii* (Howard)

Mesopleura fuscous or brownish fuscous, with a small spot at the upper anterior corner and the propleura orange yellow; eyes with a short dense pile ..... *pseudococci* (Girault)

3. Scape entirely brown; face brown with an orange tint; mesopleura orange brown ..... *greeni* (Howard)

Scape fuscous, with the base, excluding radicle, and ventral margin broadly white; face with a ferruginous or orange brown blotch beneath each antenna, but the broad median ridge black; mesopleura fuscous, with a small spot at the upper anterior corner and the propleura pale orange brown ..... *saccharicola*, n. sp.

Anagyrus saccharicola n. sp.

♀.—Form strongly depressed. Head thinly submenisciform, distinctly broader than long, with the longitudinal curvature in median line extremely slight from the occipital margin to a point a little above the anterior ends of eyes. At the latter point the curvature becomes much more abrupt toward the oral margin. Eyes moderately large, oval, about twice as long as wide and broader at the anterior end. Inner orbits very slightly divergent anteriorly and almost parallel above. The space between the eyes broad and nearly one and one-half times longer than wide. Ocelli forming a right angle, the posterior pair about their own diameter from the occipital margin and twice as far from the margins of the eyes. Cheeks short and scarcely one-half as long as width of eyes. Antennae inserted close to oral margin, the sockets being much less than half as far from oral margin as their distance apart, and somewhat less than half as far from oral margin as the distance from either to the nearest margin of eye. Antennal

scrobes in the form of rather short grooves, very slightly convergent and not at all united above and ending at a point a little above the anterior ends of eyes. They are separated by a broad convex ridge. Scape of antennae moderately expanded, rather less than one-half as broad as long (excluding radicle) and deeply grooved on the outer side between the thickened dorsal margin and the ventral expansion, with the edge of the thickened part straight and carinate. Pedicel about thrice as long as thick and distinctly longer than the following joint. Flagellum increasing very slightly in thickness toward apex. Funicle joints decreasing slightly in length distad, the first one slightly over twice as long as thick and the sixth about one and one-half times as long as thick. Club ordinary, almost equaling length of three preceding joints combined. Thorax scarcely one-half as thick dorso-ventrally as the greatest width, whereas in ordinary species the depth of the thorax is not much less than the width. Notum strongly flattened. Posterior margin of mesoscutum nearly straight except that it is slightly produced in the middle to cover the inner ends of the axillae. Axillae considerably more than twice as wide as long at outer ends, their inner ends very acute and meeting although concealed by the mesoscutum. Scutellum four-sided, about as wide as long, with the apical angle approximately rectangular, the basal angle very obtuse and the exterior angles rather acute. Apex of scutellum not at all elevated above level of propodeum and fitting into a depression in the middle of the latter. Propodeum therefore apparently composed of two lobes, broad externally and acute mesad where they are separated by the apex of scutellum. Their surface ridged on anterior margin, behind which the surface slopes very gently backward. Abdomen broadly sessile, distinctly longer than the head and thorax combined, very acute at apex and deeply concave above to the base. Ovipositor entirely concealed. Wings moderately wide, reaching to apex of abdomen. Marginal vein about twice as long as wide, the post-marginal subequal to it, and both together about equal to the stigmal vein. Disk of wing nearly uniformly setose throughout. The speculum narrow, almost reaching the stigmal vein and with an oval cut-off portion below. Proximal margin of main portion of speculum bordered with one row of distinctly coarser setae, but these setae are coarse only in comparison with the others. Costal cell with a marginal row of fine setae on the apical half. Submarginal vein with about fifteen to seventeen bristles.

Face dull, very minutely and densely alutaceous, but the scrobal grooves, summit of the ridge between antennae and the inferior inner margin of eyes shining. Mesonotum dullish, not quite so densely alutaceous as the face, the axillae somewhat smoothish, the apical margin of the scutum in the middle and apical margin of scutellum narrowly smooth and shining. Mesopleura smooth in comparison with face but dull. Propodeum smooth and shining. The more or less involuted edges of the tergum of abdomen dull and alutaceous but the concave portion and the venter shining. Pubescence of head and mesonotum extremely fine, short and whitish and although rather dense it is inconspicuous. It is erect on the face and cheeks and depressed on the notum. Occipital margin of vertex with a few longer erect fuscous setae and the superior inner orbits with a row of about six similar setae. Metapleura and sides of abdomen with pubescence similar to that of mesonotum, becoming longer, erect but sparser toward apex of abdomen. Eyes with a dense erect pubescence, about as long as that of the frons.

Head and thorax orange yellow, the tegulae and prepectal plates whitish, the oral margin of face very narrowly, occiput, dorsal surface of propodeum and the abdomen fuscous or blackish. Scape, pedicel and first funicle joint black, the following joints white. Scape with a narrow oblique band across the apical part, the dorsal margin from base to a little beyond the middle and on exterior face from there to apex, and the groove on exterior side broadly from base to apex, white. About the apical third of pedicel white. Legs, including coxae, creamy white, with the tarsi, especially middle pair, more yellowish, and the dorsal margin of the middle and hind femora and tibiae somewhat dusky. Wings hyaline, the veins dilute fuscous.

Length, 1.22 to 1.75 mm. Length of head (in specimen 1.72 mm. long), 0.397; width of head, 0.481; thickness of head, 0.213; width of vertex at anterior ocellus, 0.224; length of antenna, 0.969; length of scape (excluding radicle), 0.239; width of scape, 0.094; width of mesoscutum, 0.496; length of fore wing, 1.13; width of fore wing, 0.468 mm.

♂.—Head about ordinary in shape for males of Anagyrus, subrotund as seen from in front and slightly broader than long. Frontovertex about one and one-half times wider than long. Ocelli forming a right angle, with the posterior pair very close to occipital margin and nearly twice their diameter from margin of eyes. Eyes broadly oval, less than twice as long as wide and broader at lower end. Cheeks in frontal view nearly continuous with outline of eyes and about as long as width of eyes. Face with a broad, low, rounded, median ridge extending from clypeal margin to a little above the antennal sockets. The latter situated slightly above the ocular line, with their lower margins approximately tangent to this line, their distance apart subequal to the distance from either to the eye margin. Scrobes very short, shallow and uniting above in a broad curve. Scape short, and including radicle only slightly longer than pedicel and first funicle joint combined, narrowly oval, and slightly expanded beneath. Pedicel hardly longer than thick and about one-third as long as following joint. Flagellum elongate filiform, with rather long scattered hairs. First funicle joint nearly four times as long as thick. The following joints subequal and about two-thirds as long as first funicle joint. Club slightly longer than the last two funicle joints combined. Sixth funicle joint armed beneath with a row of six conidium-like setae and base of club with one similar seta. Thorax depressed and similar in structure to that of female. Abdomen depressed, considerably shorter than thorax and narrowly truncate at apex. Cercal plates retracted to the basal third of the length, the setae very long. Wings much shorter and broader than in the female. Speculum also much broader and reaching from stigmal vein to opposite margin of disk, except for a slight interruption which cuts off a rounded area touching the posterior margin of wing. Basal area of disk with the setae sparser and somewhat coarser than those beyond the speculum. Costal cell broader than in the female, with one marginal and one incomplete submarginal row of setae. Venation practically as in the female.

Sculpture extremely fine and alutaceous, producing an opaque effect, but the axillae, extreme apical margin of scutellum, pleura, propodeum and abdomen somewhat shining. Face with sparse, very short, appressed whitish setae. Frontovertex and mesoscutum with similar more erect, dusky setae, which are hardly visible except in profile view. Scutellum with very

sparse, rather long setae and an apical pair of longer bristles. Eyes with sparser and slightly shorter pile than in the female.

Dull black, the face on each side of the median ridge ferruginous or orange brown. Scape blackish, with the base, excluding radicle, and ventral margin broadly white. Flagellum dilute fuscous. Legs, including coxae, yellowish white, with apex of last joint of tarsi dusky. Wings hyaline, the veins dilute fuscous.

Length, 0.71 to 1.09 mm. Length of head (in specimen 0.97 mm. long), 0.317; width of head, 0.376; width of frontovertex, 0.209; width of mesoscutum, 0.396; length of fore wing, 0.865; width of fore wing, 0.399 mm.

Described from 6 females, 5 males (holotype ♀, allotype and paratypes) reared from *Trionymus sacchari* (Cockerell), collected at Serdang, Selangor, Federated Malay States, Nov. 11, 1930 (C. E. Pemberton), and 13 females, 14 males (paratypes) reared from the same host, collected at Los Banos, Luzon, Philippine Islands, August 27, 1930 (F. C. Hadden). Also a series of 6 females, 2 males (paratypes) reared from an unidentified mealybug, collected at the Tsetse-fly Laboratory, Zululand, Natal, December 10, 1925 (E. W. Rust).

ANNUAL ADDRESS

The Economic Importance of the Mediterranean Fruit Fly to Hawaiian Horticulture

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(Presented at the meeting of December 3, 1931)

The Mediterranean fruit fly (*Ceratitis capitata* Wied.) has been the subject of much discussion in recent literature, both as to its possible distribution in nature and as to its potential economic effect on horticulture. The insect has proved to be a destructive pest in every country where it has become established. In the Hawaiian Islands an almost ideal environment for the fly exists, since the temperature and humidity ranges during a great part of the year are within the optimum limits for its development and, in addition, a continuous succession of host fruits is available. These facts, coupled with the enormous fecundity of the insect, have caused its rapid increase and dissemination over the Islands, resulting in considerable damage to horticultural crops. However, after a period of more than 20 years under conditions brought about by the Mediterranean fruit fly, a substantial basis for horticulture still remains, and many fruits and vegetables are produced for local consumption.

Generally considered to be dependent on outside sources of supply for fresh produce, the Islands are largely self-supporting in this respect. Although considerable quantities of fruits and vegetables are imported for local use, this produce is of the varieties which do not grow well here because of climatic conditions or because they can be grown to better advantage elsewhere.* Hawaii not only produces large quantities of fruits and vegetables for home consumption, but could doubtless raise additional supplies for export if there were no quarantine restrictions. During the year of the fruit-fly outbreak in Florida, the Bureau of Entomology laboratory in Hawaii had an unusually large number of

* In the case of tomatoes and possibly some other fruits, insects other than the fruit fly limit their production locally.

visitors seeking information about the fly. Among these were people vitally interested in fruit growing in the States. Almost without exception these people expressed surprise at the quantity and variety of fruits grown here.

The present condition of horticulture in Hawaii, however, is no justification for the existence of the fruit fly, either here or elsewhere. It is generally agreed that absolute freedom from the pest would produce a much happier state of affairs. Neither is it an argument against the existing quarantines. The writer firmly believes that there should be no relaxation in present quarantines, and that every effort should be made to limit the distribution or spread of the fly. The pest has possibilities for great damage to horticulture in some sections of the United States. The methods by which Florida achieved apparent success in eliminating the insect from the State are hardly applicable to Hawaii at present. Nevertheless, all effort should be expended not only for better control, but looking toward the ultimate elimination of the insect from Hawaii.

HISTORY OF THE PEST IN HAWAII

An extended study of the Mediterranean fruit fly in Hawaii has been conducted by the Bureau of Entomology almost from the time the insect became established here. First found in Honolulu, in 1910, its dissemination was rather rapid, until by 1914 it had spread to all the islands of the group. Nearly ten years were required, however, for it to reach its maximum distribution and population, as is shown by yearly records of infestation started by the bureau in 1912 and continued up to the present. Willard and Bissell (8) show that the average number of larvae per fruit during the period 1916-1924 reached its maximum point in 1917 and 1918. It is interesting to note that the introduced parasites also reached their maximum, both in numbers and in efficiency of control, at about the same time.

In 1913 and 1914 the Territory successfully introduced four parasites: *Opius humilis* Silv., *Diachasma tryoni* Cam., *Diachasma fullawayi* Silv., and *Tetrastichus giffardianus* Silv., which have been of material assistance in reducing the population of the flies. These parasites have spread throughout the range of the fruit fly

and have adapted themselves to their new environment. Parasitism of the fruit-fly larvae increased yearly until 1918, when, as shown by Willard (6), a total parasitism of about 50 per cent was attained for all larvae examined. Yearly records made since then indicate little, if any increase in efficiency of the parasites. Results as shown by Willard and Bissell (8) for the years between 1916 and 1924, as well as later manuscript reports by Willard and Mason, show that the average yearly percentage of parasitism remains around 50 per cent. A fairly constant relationship between the parasites and the fruit fly has been maintained. Although an average of approximately half of the larvae are destroyed by the parasites, the amount of infestation has remained more or less stable.

EXPERIMENTAL PROCEDURE

The study of the economic effect of the Mediterranean fruit fly on horticultural crops described herein was therefore made under conditions of parasitism as outlined, and which are considered as fairly stable and continuing. Records of infestation in many of the host fruits of the fly are presented, and the relation of its injury to Hawaiian horticulture is shown. These fruits will be discussed in the order of their economic value to the islands. Unless otherwise stated, all the records were made from tree-ripened fruits. The samples of fruits were picked from the trees when they had reached a mature or edible condition. They were then taken to the insectary and placed on an inch or two of dry, clean sand in individual containers. Here they were kept, usually for 20 days. At the end of each five-day period the sand was sifted, the larvae and pupae were removed and counted, and a record was made of the number obtained. After four such siftings the total infestation for each fruit was determined. Whenever it was possible, samples were taken from several different localities in order to have representative collections.

PINEAPPLES

The pineapple (*Ananas sativus*) naturally comes first in this discussion, since pineapple growing ranks second only to sugar among Hawaiian industries. It is well known that pineapples are free from any damage by *Ceratitis capitata*. No instances are on

record in Hawaii of a pineapple being infested by this insect. Repeated attempts, as reported by Back and Pemberton (3), to rear the fruit-fly larvae under forced conditions in ripe pineapples have always failed, although these authors refer to attack on pineapples in the Fiji Islands by the pineapple fruit fly (*Dacus xanthodes* Broun) and the Queensland fruit fly (*Dacus tryoni* Frogg.), neither of which occurs in Hawaii. There are no restrictions on the exportation of this fruit.

COFFEE

Second in order of horticultural value and fifth among Hawaiian industries is the coffee crop. From the beginning of fruit-fly infestation in the Islands, coffee (*Coffea arabica*) has served as an important host of the fly. Infestation in the coffee fields rapidly increased from the start in 1912, and soon reached the point where about 90 per cent of the cherries were infested. Although it was recognized from the beginning that the larvae were in no way injuring the coffee seeds, their presence in the surrounding pulp reduced the weight of the cherries and thus disturbed the system of picking and marketing then in use, and also caused dropping of the cherries, due to fungous diseases and fermentation.

The introduction of the opiine parasites solved these difficulties at once. These parasites were liberated in the Kona coffee fields in 1914-15, and found conditions ideal for their development. The coffee cherry being a small fruit with thin flesh, the parasites could readily reach the fly larvae and oviposit in them, and there was a rapid increase in parasitism and consequent decline in fly population. This rapid reduction of fruit-fly population in the coffee fields has often been cited as an outstanding instance of parasite control. Willard (7) states that the average number of larvae per thousand coffee cherries obtained in 1917 was 765, 42 in 1923, 33 in 1924, and 19 in 1926. Some recent records of infestation in individual coffee cherries show an average of 2.1 larvae per infested fruit. On this basis the actual number of coffee cherries infested in the Kona coffee fields is less than 10 per thousand. Damage by the fruit fly has not for several years been considered a factor in coffee growing.

BANANAS

Bananas of the Chinese (*Musa cavendishii*) and Bluefield (*Musa sapientum*) types are the only other Hawaiian fruits grown for export, as well as for home use. These fruits are permitted to enter the States upon certification as to their condition of nonmaturity at the time of packing for shipment. The fruit fly has never been found infesting bananas of these types growing under natural conditions in Hawaii.

Back and Pemberton (2) report that a careful examination made of more than 30,000 fruits ready for shipment did not show a single egg puncture; also that 1,014 prematurely ripened fruits cut from bunches in the field and held in rearing jars in the insectary did not produce a single larva. Fly-traps maintained in the fields while the fruits were growing showed an abundant fly population.

Although infestation in ripe bananas on the tree can be produced under forced conditions, such is not true of green bananas on the tree, owing largely to the exudation of the tannin-laden sap which prevents the female from ovipositing. Hence, as a precautionary measure, green fruits only are permitted for export, all prematurely ripened and cracked fruits being removed from the bunches before they are wrapped. The common horticultural practice is to pick bananas while they are still hard and green so that even if the fly did attack the ripe fruits in the field, this would not be a factor in their production either for home use or for export. In his bulletin on banana culture in Hawaii (4) Pope states that "no evidence has been obtained indicating that commercial varieties are susceptible to attack by the pest. This fact has failed to receive the publicity to which the banana industry is justly entitled." This applies to the types named at the opening of this paragraph.

In the case of cooking bananas, there are a few instances on record of infestation to fruits growing under natural conditions. Back and Pemberton (2) report a single instance each of infestation in Popoulu and Moa varieties (*Musa* spp.). Willard, in an unpublished manuscript on the susceptibility of cooking bananas to attack by the fruit fly, reports that he examined 8,296

fruits of Maiamaoli bananas from Honolulu markets and found 13 of them to have egg punctures, a few of which contained dead eggs or dead young larvae. Similarly, an examination of 200 fruits of the Popoulu cooking bananas showed egg punctures in 5 fruits, from one of which 10 adult flies were reared. Cage experiments demonstrated that it was possible for adult flies to oviposit in green cooking bananas on the trees, but no adults could be reared. Only in ripe or cut green bananas was it possible to rear the flies to maturity. The few known cases of infestation in cooking bananas make it unwise to allow them to enter the States, but does not limit the production and consumption of these bananas locally.

AVOCADOS

Avocado growing has great possibilities in Hawaii, especially since the Guatemalan types have been introduced and found to meet with favor. Local markets are well supplied with these fruits throughout the greater part of the year, and only the quarantine laws prevent the development of a large industry for export purposes. It has been demonstrated that all types of the avocado (*Persea gratissima*) are possible carriers of the fruit fly, although the infestation is so slight that it is not considered in raising fruits for local use.

Figures published by Willard and Mason (9) from extensive work with Guatemalan avocados between 1925 and 1929 show that, of 1,269 fruits, representing 12 varieties grown under natural orchard conditions, only 5 fruits were infested. This represents less than four-tenths of 1 per cent of the entire lot. When adult flies were caged about the fruits on the trees for 24 hours, 1.3 per cent of 231 fruits became infested. Even when held under forced conditions in jars in the insectary, 826 fruits had infestation in only 18, or 2.2 per cent of the total number. These figures indicate that the fruit fly is a negligible factor in the production of Guatemalan avocados for local use.

The so-called summer avocados of the West Indian race are sometimes attacked more severely by the fruit fly. Even here infestation is, in the main, limited to a few trees where the fruits perhaps lack the qualities of resistance shown by most varieties.

Two hundred summer pears collected in the vicinity of Honolulu and held in the insectary for individual infestation records gave an average infestation of 4 per cent. All the infested fruits of this group came from the same tree in Manoa; five collections from other trees had no infestation. Seventy-one fruits of the Wishard variety, recently received from Haiku, Maui, had an average infestation of 25.3 per cent, while samples of several other varieties from the same orchard collected about the same time had no infestation. A tree growing in the writer's dooryard has produced several hundred high-quality fruits during the past two years and only two infested fruits have been noted.

Certainly the fruit fly receives little consideration in raising avocados for home and market use in Hawaii. Elimination of the occasionally infested tree or the varieties most susceptible to attack would almost entirely remove the fruit-fly problem from avocado growing. Even the common practice of picking avocados while they are hard, in order to facilitate handling and insure their reaching the consumer in good condition, eliminates most of the chance of infestation.

PAPAYAS

The papaya (*Carica papaya*) is an important commercial crop in Hawaii and a regular article of diet in most homes. Fruit-fly infestation in these fruits is so rare that they are not even considered by most people to be a host. The writer has never seen a papaya on the market which showed the presence of maggots. The usual commercial practice of picking papayas while they are still firm and just starting to show the ripening color removes practically all chances of infestation, since the female fly seldom, if ever, oviposits in a green papaya, as the exudation of the milky acrid juice which occurs as soon as the fruit is punctured prevents the fly from inserting her ova. In addition, experiments have shown that the young larvae are unable to live in the green fruits. If the fruits are allowed to remain on the trees until they are very soft and ripe, infestation often takes place. Of 171 such fruits, picked from the trees after becoming very soft and in most cases overripe, 23.4 per cent showed infestation. Inasmuch as papayas picked while they are still firm are considered preferable to tree-ripened fruits for culinary pur-

poses, the fruit fly can not be considered a factor in limiting their production. The fruits are, at present, so abundant that they are often used for chicken feed and hog feed.

MANGOES

The mango (*Mangifera indica*) is one of the most favored hosts of the fruit fly and perhaps its main supporting host during the summer season. Still, several of the finest varieties of mangoes in Hawaii are almost free from attack, even when growing in an environment of concentrated fly population. The common seedling mangoes, however, are so badly attacked that the crops are considered of little or no value. Infestation in certain samples of these fruits has reached 100 per cent. A comparative study made during the past two years of the infestation in several varieties of mangoes shows the average infestation to range from zero up to 58.8 per cent. In Table 1 the varieties of mangoes studied are listed in the order of their freedom from attack; and the number of fruits examined, the number infested, and the percentage of infestation are shown.

TABLE 1.—FRUIT-FLY INFESTATION IN MANGOES

Variety	Number examined	Number infested	Per cent infestation
Bierbach	18	0	0
Victoria	182	2	1.1
Pirie	121	2	1.6
Smith-Wootten	150	3	2.0
Cowasjee-Patel	37	1	2.7
Whitney	113	4	3.5
No. 9	112	5	4.4
Mullgoa	38	2	5.3
Ehrhorn	214	12	5.6
No. 5	43	3	7.0
Scott-Pirie	53	4	7.5
Wootten	144	11	7.6
Holt	63	5	8.0
Manila	100	14	14.0
Chinese	25	6	24.0
Hawaiian	643	227	35.3
French	85	50	58.8

It is seen that less than 5 per cent infestation was found in several of the best varieties of mangoes growing here. In the case of the Hawaiian mangoes infestation averaged 35.3 per cent in 643 fruits collected from several localities about Honolulu; in French mangoes it reached an average of 58.8 per cent. When it is known that most of the better varieties of mangoes examined came from trees in the experimental orchards of the Hawaii Experiment Station, in close proximity to other heavily infested host fruits, and also that flytraps maintained in the trees themselves showed large numbers of flies present during the ripening season, it will be realized that these fruits have considerable resistance to attack. The results prove, therefore, that it is possible to grow good mangoes in Hawaii in spite of the fruit fly. Pope (5) lists eight varieties as being immune or nearly free from attack. Recently some new seedling varieties have been developed with fruits of exceptional quality, color, and size, and which as yet have shown no evidence of fruit-fly injury. These facts all tend to substantiate a belief, long held by the writer, that elimination of the undesirable Hawaiian mangoes either by top-working over the trees or replacing them entirely with trees of the better varieties not only would result in the production of a superior crop of mangoes remarkably free from infestation, but also would materially reduce the fruit-fly population of the Islands by removing its main supporting summer host in the lowlands of Hawaii.

GUAVAS

The guava (*Psidium guayava*) is another of the chief supporting hosts of the fruit fly in Hawaii. Growing over a large area of the wild and mountainous portions of the Islands and extending up to the limits of range of the fly, the trees provide an almost constant supply of host fruits. The fruits are universally infested, although at the lower elevations (up to 500 feet) the average infestation and the average number of larvae per fruit are greater than at the higher elevations. In 1,485 fruits representing collections from many localities and from sea level up to 2,000 feet, the average infestation was 61.6 per cent, with an average of 10.9 larvae per infested fruit.

In making these infestation records it was found that only 3.4 per cent of the larvae emerged from the fruits during the first five days of holding, and that 45.2 per cent emerged after the tenth day. As in the case of most other fruits studied, the guavas were picked from the trees when ripe and yellow and in an edible condition, at which time, the records indicate, the insects are in the egg or first larval stage. Since fruits for processing are desired at this same stage of maturity, and are used before any decay resulting from infestation has set in, the presence of the insects does not interfere with their use or depreciate their value. Normally the fruits have fallen from the trees and are well decomposd before the larvae leave them.

Although not cultivated as a horticultural crop, the guava fruits have some commercial value in the making of jam, jellies, ice cream, etc. For these purposes, as previously explained, the infestation by the fly can not be said to lessen the value of the fruits.

Infestation of the guava fruits by the fly has apparently had no effect on the rapid spread and dissemination of the host trees over the Islands.

CITRUS FRUITS

The effect of the presence of the fruit fly in Hawaii on citrus growing is difficult to estimate, owing to the scarcity of citrus fruits for study, and especially to the absence of large plantings. Orange trees were grown more generally in the early days, and at one time oranges were exported to California, but this practice was discontinued long before the advent of the fruit fly in Hawaii. Practically all the citrus fruits consumed locally are now imported from California; so, while the fruit fly undoubtedly exerts a limiting influence on dooryard production of oranges, it is not believed that its presence affects the commercial production to a very great extent.

Some records were made in 1929-30 on oranges (*Citrus sinensis*) obtained from a planting in Kona, Hawaii. This grove, composed of about 350 sweet seedling trees, is probably the largest single planting in the Islands. From 638 fruits picked from these trees at several times during the season and held over sand in the insectary, a total of 122 larvae were obtained. Unfortunately, in-

dividual records on the fruits were not made. However, assuming 6 larvae per infested fruit, which is a conservative estimate, there were about 20 infested fruit—an infestation of about 3.2 per cent of the entire lot.

Practically all of these larvae were obtained from fruits picked in late December and January. The owner of the grove attempts to market all the fruits before Christmas, and stated that he had little trouble from fly infestation unless the fruits remained on the trees after the first of January. Back and Pemberton (1) reached a similar conclusion from their study of the susceptibility of citrus fruits to attack by the Mediterranean fruit fly. They state: "While grapefruit, oranges, lemons, and many limes may become quite badly infested with well-grown larvae if allowed to remain on the tree long after they become sufficiently ripe for the market, nature has so well equipped them to withstand attack that larvae are seldom found in their pulp until they are much overripe."

The thin-skinned oranges of the satsuma and tangerine types (*Citrus nobilis*) are much more seriously attacked. Samples taken from the small satsuma grove in Kalihi Valley, and consisting of 75 fruits which were unprotected and had ripened on the trees, had an infestation of 33 per cent. The owner of this grove finds it necessary to protect all the fruits on the trees with paper sacks in order to insure freedom from attack by the flies so that he can produce a marketable crop. In the case of the tangerines a single sample of 25 fruits had an infestation of 16 per cent. Similarly, 75 scented oranges from the experiment station orchard averaged 25.3 per cent infestation.

Lemons (*Citrus limonia*) are practically immune to damage by the fruit fly. Fifty-five Villa Franca lemons and 75 seedling lemons failed to show any infestation. Back and Pemberton (3) also state that they have never seen an infested lemon that had not been mechanically injured. Limes suffer slightly when allowed to remain on the trees until very ripe; 375 such fruits of the Kusaie lime (*Citrus aurantifolia*) were infested to the extent of 8.8 per cent. In the case of the grapefruit (*Citrus grandis*) infestation is also found in overripe fruits; 150 Whitney pomelos averaged 8.7 per cent infestation. However, all the infested

fruits were found late in the season and those picked shortly after they had reached maturity were free from attack. The sour orange (*Citrus aurantium amara*) is probably the most favored host among the citrus fruits, 76 per cent of 100 fruits having been found infested with an average of 31.5 larvae per fruit. The calamondin or Chinese orange (*Citrus japonica*), a tree grown mostly for ornamental purposes, is also a favored host, 409 of the fruits collected from several of these trees showing an average infestation of 59.2 per cent.

Most of the citrus fruits from which records were made were obtained from the Hawaii Experiment Station orchard, where they were exposed to heavy attack due to continuity of hosts and to the fact that many of the fruits remain on the trees until overripe and often until they drop.

FRUITS OF LESSER COMMERCIAL VALUE

Grapes of the Isabella variety (*Vitis labrusca*) are grown to a limited extent for local markets and home use. In 150 bunches of these grapes, representing six collections, no larvae were found when the grapes were held over sand in the insectary. Neither have any instances of field infestation in Island grapes ever been noted by the writer. Back and Pemberton (3) mention a single case of infestation found in locally grown grapes. In an effort to obtain infested grapes for experimental use, oviposition was accomplished only under forced conditions in the insectary. Later examination of these grapes showed only 133 larvae and 652 dead eggs, indicating that more than 83 per cent of the eggs failed to hatch in the grapes.

The fig (*Ficus carica*) is a favored host of the fruit fly and the fruits are often heavily infested if left on the tree until they are very soft and ripe. The milky acrid juice of the green figs, however, generally prevents oviposition by the flies. One hundred tree-ripened figs held over sand yielded a total of 342 larvae from 36 of the fruits. Only 22 per cent of the larvae emerged during the first five days of holding, however, indicating that the larvae were very small at the time the fruits were picked. The common practice of picking figs while still firm in order to facilitate market handling usually removes them from the tree before they are subject to infestation. On the other hand, on dooryard trees

bagging of the fruits is sometimes resorted to. Many lots of ripe figs purchased in the market for home use have failed to show any decay due to infestation. Complete immunity to fly attack on one variety is claimed by the grower of these figs.

The breadfruit (*Artocarpus incisa*), although listed by Back and Pemberton (3) as a host, is probably never infested. These authors state that there are no definite records of infestation available. Forty-four recently fallen and overripe fruits held in the insectary failed to produce a single larva, and no instance of infestation has been called to the writer's attention.

In the case of the mangosteen (*Garcinia mangostana*) only 1 of 75 fruits examined, or 1.33 per cent, was found to be infested.

The loquat (*Eriobotrya japonica*) is one of the favored hosts of the fruit fly. In 300 fruits, representing 12 collections, there was an infestation of 80 per cent, with an average of 8.7 larvae per infested fruit. Successful production of loquats under present Island conditions requires bagging of the fruits, but these fruits have little commercial value.

Sapodillas (*Achras sapota*) are also heavily infested when grown unprotected. A small sample of fruits held in the insectary had an infestation of 62.5 per cent. Only an occasional tree of this species grows in the Islands and the fruits are in little demand.

The strawberry guava (*Psidium cattleianum*) is severely attacked by the fruit fly when allowed to mature on the trees, 250 fruits having an average infestation of 72.8 per cent. As in the case of the regular guavas and figs, however, oviposition rarely takes place until the fruits are very soft and ripe. Only a small percentage of the larvae in the samples of tree-ripened fruits under observation emerged during the first five days of holding. Since the chief use of the strawberry guava is for cooking and jelly making, the presence of the insects in the egg and early larval stages can not be said to depreciate their value very much.

Two samples of mountain apples (*Jambosa malaccensis*), taken at the lower altitudes of its range and near cultivated host fruits of the fly, were infested to the extent of 58 per cent. Usually growing wild well up in the mountain forests, the fruits of this tree are ordinarily free from infestation, and good fruits are commonly offered for sale during the season.

FRUITS OF DOUBTFUL COMMERCIAL VALUE

Another group of fruits, although of rather doubtful commercial value, will be considered here since it contains some important hosts of the fruit fly. This group contains the star apple (*Chrysophyllum cainito*), rose apple (*Eugenia jambos*), French cherry (*Eugenia uniflora*), white sapota (*Casimiroa edulis*), carambola (*Averrhoa carambola*), and Natal plum (*Carissa arduina*). These fruits are grown to a limited extent in home gardens either for food value or ornamental purposes.

Infestation records as determined for these fruits are given as follows: 235 star apples, representing 10 collections of fruits, had an average infestation of 50.2 per cent; in 400 rose apples there was an average of 76 per cent attacked, two of the samples of 25 fruits each showing 100 per cent infestation; 19 collections of French cherries, representing a total of 475 fruits, varied in degree of infestation from 8 to 100 per cent, with an average of 53 per cent; 3 small samples of white sapotas, representing 33 fruits, were 100 per cent infested in each case; 5 lots of carambolas, with a total of 122 fruits, contained 3 infested fruits, or an average infestation of 2.4 per cent; Natal plums were 14 per cent infested in 4 collections, representing 100 fruits.

VEGETABLES

This discussion will not be complete without considering some of the vegetable crops which are purported to be hosts of the fruit fly. In this connection the attack of the fruit fly must not be confused with the damage caused by the melon fly (*Bactrocera cucurbitae* (*Coq.*)), a related insect which is primarily an enemy of certain vegetable crops.

The tomato (*Lycopersicum esculentum*), although commonly considered as a host, has never been found to be attacked. From 648 fruits, representing 25 different collections, no larvae were obtained when the fruits were held in the insectary. Neither are any authentic records available of fruit flies having been reared from tomatoes grown under natural field conditions. Tomatoes have often been infested artificially and the larvae reared through in them, but they are not attacked in the field. Although listing tomatoes as a host of the fruit fly, Back and Pemberton (3) have not recorded any instances of natural infestation.

Eggplants (*Solanum melongena*) are also listed by Back and

Pemberton (3) as hosts, but their records show only one infested fruit from 1,115 examined, or less than one-tenth of 1 per cent. In an effort to obtain infested eggplants for experimental use, 132 fruits were placed in jars containing adult flies and held in the insectary. Even under such forced conditions, infestation was obtained in only 3 of these fruits. Hence it appears that eggplants are most improbable hosts of the fruit fly.

Onions are sometimes considered as possible carriers of the fruit fly. Work conducted a few years ago by H. F. Willard, and reported in manuscript only, shows that the fruit fly could not be reared through in onions of the Australian brown and Spanish types. Although adult flies would deposit eggs in the onions under forced conditions, none of them were able to develop. No instances are on record of infestation in onions in Hawaii. The same is true of beans of all types, although broadbeans have been reported (in correspondence) as a host in Bermuda.

Melons of all kinds are severely infested by the melon fly, but not by the fruit fly. Although fruit flies have often been reared from melons infested in the insectary, no records are obtainable of infestation under field conditions.

The green pepper (*Capsicum annuum*) is the only vegetable in which natural infestation by the fruit fly has been found. Among 197 green peppers purchased in the local markets, 19 infested fruits were found, or an average of 9.6 per cent infestation, and with an average of 5.2 larvae per infested fruit. Another lot of several sacks of green peppers was purchased for cold-storage experiments, and from 150 fruits selected from the lot as checks to determine the larval population, 66 larvae were obtained. Figuring the individual infestation on the average of 5.2 larvae per fruit as given above, about 12 fruits, or an average of 8 per cent of the lot, were infested. This figure is comparable with that of the first lot, and shows that green peppers average about 9 per cent infestation. As in the case of some previously mentioned fruits, only about 25 per cent of the larvae emerged during the first five days of holding. Hence, it will be seen that little decay or loss results from fruit-fly infestation in peppers.

CONCLUSION

Infestation records are included on all the important supporting hosts of the Mediterranean fruit fly, and the injury to such

hosts is indicated. These records show that Hawaii is able to grow an abundant crop of fruits and vegetables for home use, and in some cases for export, with little loss caused by the fly. Although severe infestation does take place in some varieties of citrus fruits and mangoes, in peaches, guavas, figs, and some of the minor fruits, including both edible fruits and fruits of ornamental plants and trees, some of these host fruits are not of commercial value, or can be picked before infestation occurs or used in ways to overcome the factor of infestation. The green pepper is the only vegetable crop whose production is affected by fruitfly infestation. Among the fruit crops the production of pineapples, bananas, avocados, papayas, some kinds of citrus fruits and mangoes, grapes, breadfruit, mangosteens, and some other lesser important fruits is scarcely, if at all, limited by the presence of the fly. Strawberries, mulberries, pohas, and some of the other minor fruits are not classed as hosts.

The growing of more resistant varieties of some of the favored hosts, elimination of nonessential host fruits, and a program of control through orchard and dooryard sanitation, together with the use of poison bait spray, would probably result in largely removing the insect from the lowlands of Hawaii.

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Some Observations on Forest Insects at the Nauhi Nursery and Vicinity on Hawaii

BY O. H. SWEZEY AND F. X. WILLIAMS

(Presented at the meeting of November 5, 1931)

Through the courtesy of the department of forestry, the writers had the opportunity of spending a week the latter part of September and beginning of October, 1931, at the forest nursery on Nauhi Gulch, at an elevation of 5,250 feet. This is at the upper edge of the Hilo Forest Reserve, and in the land of Honohina, about 12 miles up from the coast. This region of this great forest belt on windward Hawaii has never been explored entomologically. During the few days there, we studied the insect faunas of the chief trees making up the jungle in the forest reserve, and the remaining trees in the ranch land which occupies a wide belt above the forest. We also went up the side of Mauna Kea above the forest line to an elevation of 8,500 feet, and one day made the ascent to the summit of Mauna Kea, under the guidance of the forest ranger, Joe Ignacio. (The insects captured at the summit are listed on pages 191-192 of this issue.)

The koa (*Acacia koa*) is a prominent tree of the region, and, as evidenced by standing dead trunks and rotten logs, formerly made up a considerable part of the forest that previously covered the land which has been occupied as ranch for a long period of time. There are some remaining living trees on the ranch area, particularly in and along the gulches. The most prevalent tree in the forest reserve is the ohia lehua (*Metrosideros polymorpha*). It also extends somewhat up into the ranch area. The mamani (*Sophora chrysophylla*) makes up a considerable belt of open forest at an elevation of 7,000 to 8,500 feet, with scattering trees at lower elevations. The naio (*Myoporum sandwicense*) has scattered stands in the ranch area. Koolea (*Suttonia lessertiana*) is found sparsely in the forest reserve and also somewhat higher up. The same applies to olapa (*Cheirodendron gaudichaudii*). The mamake (*Pipturus albidus*) is not common and *Broussaisia arguta* is more in evidence in the forest reserve. A species of

Coprosma is quite common in the jungle of the forest reserve and is also found in the gulches at higher elevations.

Of the undergrowth making up the jungle of the forest reserve there are many pulu ferns (*Cibotium chamissoi*). *Dryopteris paleacea* is another very abundant fern. There are thickets of akala (*Rubus hawaiiensis*), and clumps of a tall species of ohelo (*Vaccinium* sp.) are common. Puakeawe (*Cyathodes tameiameia*) is also abundant in places.

Certain trees which are usually components of the endemic forests were not observed in the region, namely: Straussia, Bobea, Pelea, Elaeocarpus, Antidesma, Perrottetia and Maba. It is significant to note that although there were quite a number of kinds of insects present whose habits are feeding on dead and decaying wood, no termites were found in the region. In any other regions where we have studied the insect relations to the endemic forest trees, the large termite, *Neotermes connexus* Snyder, has been found inhabiting dead branches and logs of nearly every kind of tree. Whether the elevation was higher than the natural habitat of this termite remains yet to be determined. It will be a problem of interest to ascertain just what is the upper limit in the distribution of this termite, which inhabits the native forests of all the islands, not, however, coming down onto the lowlands, though it has been found as low as about 500 feet on Oahu. It is also worthy of mention that none of the immigrant ants of the lowlands were found in the Nauhi region, nor any earwigs, nor was the widespread carpenter bee observed.

None of the large centipede was seen, but the short small lithobiid centipedes were everywhere abundant, as were also sowbugs and millipeds in rotten wood and under bark. Other animal life of interest in the region: abundance of egg-masses of Succinea snails, clear, glass-like, watery, and glistening, hanging from fern fronds in the damp koa forests; well before dusk a bat is on the wing at Nauhi; in the mamani zone a few of the Hawaiian buzzard (*Buteo solitarius* Peale) were seen on the wing or perched in trees; the native parrot-like *Loxioides bailleni* Oust. was quite abundant in the mamani trees.

The list of insects which follows gives a fair indication of the native insect fauna of the region, but much more time would be

required to make a complete entomological survey of the native forest trees growing there.

HYMENOPTERA

APIDAE

Apis mellifera Linn. Common, even far up in the mamani belt (*Sophora chrysophylla*) 8,000 feet or more elevation, where they were seen at the flowers of this tree.

HYLAEIDAE

27 **Nesoprosopis difficilis** Perkins. Collected on Sophora and Raillardia.
1 **Nesoprosopis comes** Perkins.

PEMPHREDONIDAE

1 **Nesomimesa hawaiiensis** Perkins. One female on koa at Keanakolu. Rare.

CRABRONIDAE (The fly-catching wasps))

3 **Xenocrabo polynesialis** (Cameron).
3 **Xenocrabo atripennis** (Perkins). One from cocoon in soil.
1 **Xenocrabo hawaiiensis** (Perkins).
3 **Hylocrabo tumidoventris** var. **leucognathus** (Perkins). From cocoons in rotten logs.
25 **Nesocrabo rubrocaudatus** (Blkb. & Cam.). Rather abundant. Several of its nesting sites were found. Above the highwater mark of a permanent stream in Nauhi gulch, nest holes of one to two, or possibly more cells were found under stones in black sandy soil, and one cocoon from the lot collected yielded a wasp. Three more were reared from cocoons in decayed logs. Several females were observed on a mossy little hummock of soil, excavating burrows. One of these wasps, carrying a metallic green or blue native sarcophagid fly, was captured. These flies were very abundant in the Nauhi region.

EUMENIDAE (Caterpillar-catching wasps)

21 **Odynerus peles** Perkins.
1 **Odynerus venator** Perkins.
3 **Odynerus cyphotes** Perkins.
13 **Odynerus heterochromus** Perkins.
2 **Odynerus sociabilis** Perkins.

PSAMMOCHARIDAE (Spider-catching wasps)

1 **Anoplius luctuosus** (Cress.). Not plentiful at Nauhi, 5,250 feet; also seen at 8,500 feet, and at Lake Waiau, 13,007 feet, and at the summit of Mauna Kea, 13,750 feet. At Lake Waiau, where there were a few small weeds and grass and various stray insects, a rather large active evidently diurnal lycosid (?) spider was active, and it is not impossible that the Anoplius wasp preyed upon this spider here and was not, as with most other insects, merely a wind-blown visitant to these bleak heights.

BETHYLIDAE

10 **Undetermined Sierola,** several species. Swept from several kinds of trees.

5 **Sclerodermus sp.** Collected in dead koa log. Probably parasitic on *Oodemas corticis.*

DRYINIDAE

1 **Pseudogonatopus perkinsi** (Ashm.). Swept from lehua. Probably parasitic on *Leialoha lehuae hawaiiensis.*

PROCTOTRYPOIDEA

Exallonyx philonthiphagus Williams. Nauhi gulch, Sept. 30, in an old *Acacia koa* log, 6 larvae of the staphylinid beetle *Philonthus turbidus,* apparently pupating, were found parasitized by a rather large species of this wasp. Each beetle larva had a proctotrypid pupa partly extruded from the underside of the abdomen. Several of the wasps matured.

FIGITIDAE

2 **Eucoila impatiens** (Say). Parasitic on dipterous larvae in cowdung.

4 Undetermined species.

ICHNEUMONIDAE

2 **Amblyteles koebelei** (Swezey). Common in ranch lands. Parasitic on armyworms.

2 **Amblyteles purpuripennis** (Cress.). Common in ranch lands. Parasitic on armyworms.

4 **Amblyteles** sp. (A smaller species).

3 **Ephialtes hawaiiensis** (Cam.).

1 **Diplazon laetatorius** (Fab.).

1 **Enicospilus tyrannus** Perkins. Reared from cocoon in rotton log. It had evidently parasitized a larva of *Scotorythra hyparcha,* and the larva had formed its pupal cell in the log.

4 **Enicospilus longicornis** Ashm. One from a cocoon in rotten log, and evidently a parasite of some species of Scotorythra.

7 **Enicospilus castaneus** Ashm.

1 **Enicospilus funereus** Perkins.

1 **Eremotyloides orbitalis** (Ashm.).

2 **Angitia blackburni** (Cam.). Reared from larvae of *Omiodes scotaea* on Astelia.

3 **Hyposoter exiguae** (Vier.). Reared from Scotorythra larvae on several kinds of trees.

10 **Atrometus flavifrons** Ashm. Swept from various trees.

ALYSIIDAE

6 **Aphaereta muscae** Ashm. On manure. A parasite of the puparia of the hornfly and other Diptera.

12 **Aspilota konae** Ashm.

MISCOGASTERIDAE

2 **Toxeuma sp.** Probably parasitic on *Proterhinus ferrugineus* in tree ferns.

ENCYRTIDAE

1 **Eupelmus chalcoprepes** Perkins.

PTEROMALIDAE

1 **Spalangia cameroni** Perkins. Parasitic in hornfly puparia.

EULOPHIDAE

2 **Secodella metallicus** (Ashm.).

MYMARIDAE

2 **Polynema pyrophila** Perkins. Swept from koa and lehua.

6 Undetermined chalcid-flies.

COLEOPTERA

CARABIDAE

4 **Colpodiscus lucipetens** (Blkb.).
3 **Colpocaccus hawaiiensis** Sharp. In dead stems of tree ferns.
4 **Mesothriscus hawaiiensis** Sharp.
45 **Mecyclothorax konanus** Sharp. In rotten koa logs and dead stems of tree ferns.
2 **Mecyclothorax sp.** near **vulcanus** (Blkb.). In dead stems of tree fern.
3 **Mecyclothorax sp.** near **montivagus** (Blkb.).
16 **Thriscothorax gracilis** Sharp. In rotten koa logs.
1 **Thriscothorax sp.** near **bembidioides** (Blkb.). In dead stem of tree fern.
5 **Thriscothorax variipes** Sharp. In dead stems of tree ferns.
8 **Thriscothorax karschi** (Blkb.).
5 **Metrothorax deverilli** (Blkb.). In dead stems of tree ferns and under bark of lehua.

DYTISCIDAE

1 **Rhantus pacificus** (Boisd.). Adults common in a Nauhi stream; larvae in boggy pool by trail.

STAPHYLINIDAE

1 **Philonthus longicornis** Steph. Common in cowdung.
6 **Philonthus turbidus** Erichs. Pupal cells found in rotten koa logs. A proctotrypid parasite reared from some of the larvae.
4 Undetermined staphylinids.

NITIDULIDAE

23 Undetermined specimens collected from tree ferns, lehua, Coprosma and Sophora.

ELATERIDAE

Eopenthes konae Blkb. Fragments in rotten koa log.

MELASIDAE

Dromaeolus perkinsi Sharp. Elytra in rotten koa log.
Dromaeolus obtusus (Blkb.). (?). Elytra in rotten koa log.

HISTERIDAE

1 Undetermined specimen in dead stem of tree fern.

COCCINELLIDAE

4 **Pullus kinbergi** (Boh.).

1 **Lindorus lophanthae** Blaisd.

Coelophora inaequalis (Fab.). Observed but not collected.

Cryptolaemus montrouzieri Muls. Observed but not collected.

CHRYSOMELIDAE

8 **Diachus auratus** (Fab.). On various kinds of trees.

CIOIDAE

3 **Cis porcatus** Sharp. Beaten from lehua and Coprosma.

2 **Cis cognatissimus** Perkins. Under bark of Coprosma.

2 **Cis signatus** Sharp.

12 **Cis pacificus** Sharp. In bracket fungus.

14 **Apterocis n. sp.** near **strigosus** Perkins. In bracket fungus on dead koa.

CERAMBYCIDAE

1 **Neoclytarlus claviger** (Shp.). Collected on post at Keanakolu.

10 **Plagithmysus blackburni** Sharp. Collected on dead mamani tree; larvae numerous in dying trees.

18 **Plagithmysus varians** Sharp. Mostly reared from larvae and pupae in dead branches of koa. One collected on Myoporum. One collected in cabin at Keanakolu (Ignacio).

Plagithmysus perkinsi Sharp. Larvae in dying Myoporum tree. One adult beetle issued August 21, 1932.

Plagithmysus vitticollis Sharp. Larvae found in Rubus, but none reared.

Aeschrithmysus swezeyi Perkins (?). Borings found in stems of Raillardia at 8,500 feet elevation; one larva found which failed to mature. Borings were found in Cyathodes also at the same place, which might have been by larvae of a related species.

Aeschrithmysus n. sp. Larvae found in *Vaccinium peleanum* at 8,500 feet elevation. One adult beetle matured November 27.

PROTERHINIDAE

1 **Proterhinus blackburni** Sharp.

6 **Proterhinus vulcanus** Perkins. Collected from Coprosma and dead stems of tree fern.

24 **Proterhinus ferrugineus** Perkins. Abundant in dead stems of tree ferns.

4 **Proterhinus deceptor** var. **major** Perkins. Beaten from dead branches of lehua.

3 **Proterhinus sp.** near **innotabilis** Perkins. Beaten from dead branches of Suttonia.

1 **Proterhinus** (undetermined). From Myoporum.

CURCULIONIDAE

Pantomorus godmani (Crotch). Common on various kinds of trees and plants, sometimes destructive to recently planted young seedling trees.

1 **Listroderes apicalis** Waterh. Under koa bark.

6 **Dryophthorus declivis** Sharp. In dead koa logs.

20 **Dryophthorus insignis** Sharp. In rotten koa logs and dead stems of tree ferns.

22 **Dryophthorus n. sp.** In koa and lehua logs.

3 **Pentarthrum prolixum** Sharp. In dead stems of tree ferns. Not so common as usual.

22 **Oodemas corticis** Perkins. Common in standing dead koa trunks.

11 **Oodemas n. sp.** between **chrysodorum** and **cupreum.** In pith of dead Rubus stems.

20 **Nesotocus munroi** Perkins. Collected on Cheirodendron on the Laupahoehoe trail by Joe Ignacio, the forest ranger.

PTINIDAE

3 **Xyletobius proteus** Perkins. In dead Coprosma.

LEPIDOPTERA

Unless otherwise stated, the moths of this list were taken at lights when they came very abundantly on some of the nights. Hundreds would be present at a time on the outside of the windows and the porch ceiling. An attempt was made to secure samples of all species observed. Probably the most numerous among these moths were *Scotorythra paludicola, Scotorythra hyparcha* and several species of Scoparia. The numbers of specimens given in the list will indicate the relative abundance of the different species.

CARADRINIDAE

2 **Hyssia compsias** (Meyr.).

2 **Cirphis unipuncta** (Haw.). Pupae were common in rotten koa logs in grassy places.

1 **Lycophotia margaritosa** (Haw.). Found under stone at 7,000 feet elevation.

1 **Euxoa baliopa** (Meyr.).

1 **Agrotis selenias** Meyr.

1 **Agrotis coniotis** Hamp.

PLUSIADAE

2 **Hypenodes altivolans** (Butl.).

HYDRIOMENIDAE

2 **Eucymatoge monticolans** (Butl.). One reared from larva but its host tree not recorded—probably Cyathodes.

SELIDOSEMIDAE

22 **Scotorythra paludicola** (Butl.). This is the moth whose caterpillars defoliated the koa trees in the forest east of Olinda, Maui, in 1926. A few caterpillars were found on the koa trees at Nauhi, but not enough to be injurious. None was reared. A few caterpillars found on Sophora might have been the same species.

1 **Scotorythra oxyphractis** Meyr.

7 **Scotorythra hyparcha** Meyr. All were males. No caterpillars of this abundant species were found. It is thought that they feed on the lehua tree. Several of their pupae were found in rotten koa logs and 2 or 3 moths reared from them. A parasite, *Enicospilus tyrannus* Perk., issued from a cocoon in one of the pupal cells where it had issued from a caterpillar of this moth.

NYMPHALIDAE

Vanessa tammeamea Esch. This butterfly was observed, and its caterpillars also observed on Pipturus. None was reared or collected.

PIERIDAE

Pontia rapae (Linn.). One butterfly seen on the wing at 8,500 feet elevation.

LYCAENIDAE

Lycaena blackburni (Tuely). A few larvae were found on new foliage of koa. None reared.

PYRAUSTIDAE

1 **Omiodes accepta** (Butl.). The common grass leafroller.

4 **Omiodes scotaea** (Hamps.). Reared from larvae on Astelia.

8 **Phlyctaenia endopyra** Meyr. The larvae found on leaves of Rubus, a very abundant shrub.

9 **Phlyctaenia pyranthes** Meyr. The larvae feed on the leaves of *Vaccinium calycinum*. There were many clumps of this shrub, and the leaves were badly eaten. None reared.

2 **Nomophila noctuella** Schiff.

3 **Scoparia balinopis** Meyr.

1 **Scoparia orthoria** Meyr.

5 **Scoparia halirrhoa** Meyr.

9 **Scoparia crataea** Meyr.

1 **Scoparia pyrseutis** Meyr.

3 **Scoparia thyellopis** Meyr.

1 **Scoparia melichlora** Meyr.

7 **Scoparia meristis** Meyr.

1 **Scoparia platyscia** Meyr.

PTEROPHORIDAE

3 **Platyptilia fuscicornis** Z.

4 **Platyptilia insularis** Walsm.

GELECHIADAE

Thyrocopa indecora (Butl.). One reared from larva in dead wood of Sophora.

DIPLOSARIDAE

Hyposmocoma chilonella triocellata Walsm. One reared from larva in pith of dead Rubus.

CARPOSINIDAE

1 **Heterocrossa gracillima** Walsm. Larva feeds in the fruits of Cyathodes.

Heterocrossa sp. Larva in terminal bud of Vaccinium. Not reared.

Heterocrossa sp. Larvae in fruits of Vaccinium. Not reared.

TORTRICIDAE

Adenoneura plicatum Walsm. One swept from Sophora. Probably the moth whose larvae feed in Sophora pods.

1 **Adenoneura montanum** Walsm.

Argyroploce illepeda fulva (Walsm.). Four reared from koa pods. The pods were found badly infested. A count was made of 87 pods, and 61% of the seeds were found to have been destroyed.

Bactra straminea (Butl.). Larvae found boring in the stems of Carex. One reared.

Archips postvittanus (Walk.). One each reared from Rubus and pumpkin vine.

Eulia sp. Larvae boring stems of Suttonia. None reared.

Epagoge infaustana Walsm. Larvae were found in terminal buds and leaves of Pipturus. None reared.

TINEIDAE

Opogona omoscopa (Meyr.). Abundant. Larvae abundant in rotten logs and other decaying vegetation.

DIPTERA

MYCETOPHILIDAE

Sciara sp. One male.

CHIRONOMIDAE

Ceratopogon sp. One female.

Tanytarsus sp. Swarms of males of this delicate green midge hovering over the water of a small stream.

PSYCHODIDAE

Psychoda alternata Say.

CULICIDAE

Culex quinquefasciatus Say. An egg-raft of this mosquito and some larvae probably of the same species found in a wooden water trough at Keanakolu. An adult heard buzzing in a cabin room at night at the same place. Larvae seen also in a spring pool at Nauhi. (Eggs of Culex have been found in a rain barrel, at an altitude of over 6,000 feet on Hualalai by the junior author, in 1929).

LIMNOBIIDAE (Crane-flies)

Adults common, probably several species.

DOLICHOPODIDAE

Medeterus sp. One male.

Campsicnemis spp. At least 4 species of water-riding flies of this family. The males have the middle pair of legs somewhat modified.

BORBORIDAE

Undetermined species on manure at 6,000 feet elevation.

LONCHOPTERIDAE

14 **Lonchoptera furcata** Fallen (?).

DROSOPHILIDAE

Drosophila sp. A large species common at a wound on a Coprosma tree at Keanakolu.

Drosophila sp. One specimen of a large species in water at Nauhi.

ANTHOMYIDAE

2 **Lispocephala dexioides** (Grims.).

Several undetermined species.

MUSCIDAE

1 **Phormia regina** (Meig.). Collected above 7,000 feet elevation.

SARCOPHAGIDAE

7 **Prosthetochaeta obscura** Grims. (?) Abundant.

OESTRIDAE

Gastrophilus intestinalis De Geer. One reared from a puparium found in horse manure at Hopuwai.

EPHYDRIDAE

Brachydeutera hebes Cress. Common on and about puddles at Nauhi. Breeding in water in an iron pot at Keanakolu.

Scatella sex-notata Cress. Breeding in the water in an exposed tree hollow at 6,000 feet at Nauhi.

Scatella hawaiiensis Grims. At creek pool at Nauhi.

Scatella wings in log water trough at Keanakolu.

HIPPOBOSCIDAE

1 **Melophagus ovinus** (Linn.). In saddle room at Keanakolu.

HETEROPTERA

CIMICIDAE

9 **Oechalia grisea** Burm. Common on lehua, koa, mamani, Coprosma, and other trees.

Coleotichus blackburniae White. Nymphs numerous on koa pods at Keanakolu (Ignacio).

GEOCORIDAE

14 **Nesocymus calvus** (White). On Carex.

Nysius spp. Four undetermined species quite common on koa, Raillardia, Sophora, and Astelia.

NABIDAE

1 **Reduviolus capsiformis** (Germ.).
9 **Reduviolus subrufus** (White). On lehua and koa.
6 **Reduviolus kahavalu** Kirk. On Sophora.

GERRIDAE

3 **Microvelia vagans** White. This minute water-strider was common on pools at Nauhi. Sometimes gathered about fallen insects.

ANTHOCORIDAE

1 **Lasiochilus denigratus** (White). In dead stem of tree fern.

MIRIDAE

1 **Hyalopeplus pellucidus** (Stal).
3 **Nesiomiris sp.** near **hawaiiensis** Kirk. On Cheirodendron.
4 **Koanoa hawaiiensis** Kirk. On lehua and Cheirodendron.
9 **Koanoa n. sp.** On Raillardia at 8,500 feet elevation.
1 **Sarona adonias** Kirk. On lehua.
28 **Tichorhinus perkinsi** (Kirk.). Very abundant on Coprosma.
45 **Tichorhinus sp.** Very abundant on Coprosma.
3 **Tichorhinus sp.** On lehua and Suttonia.
15 **Psallus sp.** near **swezeyi** Kirk. Common on Sophora.

ACANTHIIDAE

2 **Acanthia oahuensis** (Bkb.). About Nauhi streams.

POEKILOPTERIDAE

Siphanta acuta (Walk.). Common on lehua and most kinds of trees.

CIXIIDAE

2 **Oliarus kanakanus** Kirk. On lehua.
6 **Oliarus filicicola** Kirk.
2 **Iolania perkinsi** Kirk.

DELPHACIDAE

20 **Leialoha lehuae hawaiiensis** Muir. On lehua.
10 **Ilburnia koae** (Kirk.). Common on koa.
18 **Ilburnia pseudorubescens** (Muir). Common on koa.
14 **Ilburnia ipomoeicola** (Kirk.). On Sadleria and Lythrum.
27 **Ilburnia chambersi** (Kirk.). On Raillardia at 8,500 feet elevation.
12 **Ilburnia mauiensis** Muir. On Tetramolopium at 8,500 feet elevation.
1 **Ilburnia sp.** near **nesopele** Muir. On Astelia.
1 **Ilburnia sp.** On Dubautia.

CICADELLIDAE

22 **Nesosteles sp.** Common on Cyathodes.
4 **Nesophrosyne sp.** On Pipturus.
7 **Nesophrosyne sp.** On Broussaisia.
13 **Nesophrosyne sp.** On Coprosma.
5 **Nesophrosyne sp.** On Coprosma.
2 **Nesophrosyne sp.** On lehua.

PSYLLIDAE

3 **Trioza hawaiiensis** Crawfd. On lehua. Unusually scarce.

CORRODENTIA

2 **Psocus sylvestris** Perk. On Myoporum.
2 **Elipsocus inconstans** Perk. On lehua.
1 **Elipsocus psylloides** Perk. On Cheirodendron.
2 **Elipsocus criniger** Perk. On Suttonia and Sophora.
5 **Elipsocus vinosus** McLach. On Suttonia and Cyathodes.
1 **Elipsocus micramaurus** Perk. On lehua.
1 **Caecilius analis** Banks. On Cheirodendron.

ORTHOPTERA

GRYLLIDAE

Paratrigonidium sp. Several feebly-chirping crickets were heard down the Nauhi gulch.

Leptogryllus sp. A few found in tree fern stems.

LOCUSTIDAE

Oxya chinensis (Thunb.). One collected on grass down Nauhi gulch.

BLATTIDAE

5 **Allacta similis** (Sauss.). This roach which is common in hollow stems and under bark at lower elevations, was found only indoors at Nauhi, the specimens all taken in the cabin.

ODONATA

AGRIONIDAE

Agrion deceptor McLach. Rare. One male taken at 6,000-7,000 ft. elevation.

Agrion sp. Two nymphs were taken at the leaf bases of the small Astelia plants, 5,150 ft. elevation. The alimentary tract of one specimen contained what appeared to be a mite (Acari).

Agrion sp. Nymphs were common in a little stream. Stomach contents showed that they fed largely on chironomid larvae, probably Tanytarsus, and oribatid mites.

LIBELLULIDAE

Pantala flavescens Fabr. One adult observed above 8,000 ft.

Anax strenuus Perkins. Two adults seen. Nymphs reported by the forester.

NEUROPTERA

HEMEROBIIDAE

2 **Nesomicromus vagus** Perkins.
1 **Anomalochrysa hepatica** Perkins. Collected on lehua.

COLLEMBOLA

A number of these minute insects collected in and under decayed wood, etc.

Insects From the Summit of Mauna Kea

BY O. H. SWEZEY AND F. X. WILLIAMS

(Presented at the meeting of November 5, 1931)

On October 5, 1931, the ascent of Mauna Kea was made, Forest Ranger Joe Ignacio acting as guide, and the trip made from the Keanakolu ranger station at an elevation of 5,250 feet. The following insects were collected mostly at Lake Waiau, 13,007 feet elevation. Several of the flies (particularly *Chaetogaedia monticola*) were quite common at the very summit of the mountain, 13,784 feet elevation. Quite a number were found drowned in a soda water bottle which had not been entirely emptied, left by a recent visitor. Some of the specimens were in too poor condition for determination.

From Soda Water Bottle.

HYMENOPTERA

2 *Amblyteles koebelei* (Swezey).
1 *Amblyteles purpuripennis* (Cress.).
1 *Hyposoter exiguae* (Vier.).

LEPIDOPTERA

3 *Euxoa mesotoxa* (Meyr.).

DIPTERA

2 *Chaetogaedia monticola* (Bigot).
3 *Calliphora vomitoria* (Linn.).
2 *Sarcophaga haemorrhoidalis* Fall.
3 Undetermined muscids.
2 Undetermined anthomyids (?).
1 *Agromyza pusilla* Meig.
1 Myectophilid (?).
1 Chironomid (?).

HEMIPTERA

2 *Nysius delectus* White.

Others Collected Chiefly at Lake Waiau.

HYMENOPTERA

1 *Polistes fuscatus* var. *aurifer* (Sauss.). Fragments at summit.
1 *Amblyteles purpuripennis* (Cress.).
Anoplius luctuosus (Cress.). Observed at Waiau, but not caught. A spider was also noticed under stones and was probably preyed upon by this wasp.

LEPIDOPTERA

1 *Adenoneura montanum* Walsm.
1 Scotorythra (?). Fragments at summit.

DIPTERA

4 *Chaetogaedia monticola* (Bigot).
3 *Haematobia irritans* (Linn.). Perhaps came up on the horses.
1 *Phormia regina* (Wied.).
1 *Piophila casei* (Linn.).
1 *Eristalis tenax* (Linn.).
2 *Simosyrphus grandicornis* (Macq.). One at the summit.
1 *Allograpta obliqua* (Say).
1 *Brachydeutera hebes* Cress.
1 *Sciara* sp.
1 Cecidomyid (?).
Tipulids were observed at the lake, but not caught.

COLEOPTERA

1 Small staphylinid. Under stone.

HEMIPTERA

3 *Nysius delectus* White.
1 *Peregrinus maidis* (Ashm.). On surface of lake.
1 *Ilburnia pseudorubescens* (Muir). On surface of lake.
1 Green Cyathodes jassid. On surface of lake.
1 Aphid. On surface of lake.

Notes on a Small Collection of Philippine Weevils That Feed in the Fleshy Receptacles or "Fruits" of Wild Figs

BY FRANCIS X. WILLIAMS

(Presented at the meeting of July 2, 1931)

While in the Philippine Islands in 1920-1922, the writer made a study of native fig trees (*Ficus* spp.) particularly on Mt. Makiling, Los Baños, Luzon, a region notably rich in these plants. Many insects were found in more or less close association with these Ficus, being attached chiefly to their fleshy receptacles or "fruits".

Among the insects bred from, or found on, or in fig receptacles in the Mt. Makiling region were species of weevils—some of which seem to favor certain groups or types of figs rather than species of them. One or more weevil larvae may be found in a single receptacle which eventually falls to the ground. As a rule, these weevils leave the fig as full-fed larvae, pupate in the soil and issue some weeks later; it is certain, however, that other fig weevils complete their transformations within the receptacles.

A number of the Ficus were determined some years ago by Dr. E. D. Merrill, one-time director of the Philippine Bureau of Science, Manila.

Thanks are due to Dr. G. A. K. Marshall, Director of the Imperial Bureau of Entomology, London, and to Dr. K. M. Heller* of Dresden, for the determination of the collection of weevils, all from Mt. Makiling, and on which some notes are now presented.

1. **Balaninus ascendens** Heller. Reared from the furry receptacle of *Ficus xavieri* Merrill, a strangling fig, or "banyan"; Mt. Makiling, lower forest, Feb. 1921. Another specimen labelled: "examining 1/3-size fruit of *Ficus nota* (Blanco)"—"Apr. 1921"—, a dioecious tree not of the banyan type.

This weevil is blackish with a transverse and longitudinal pattern in white scales.

2. **Balaninus basilaris** Heller. Reared from the receptacle of *Ficus indica* Linn., Feb. 1921 and Nov. 1921.

* See Studien zur *Balaninini*, II, Stett. Ent. Zeit., 88, 175-287, 2 pls., 1927.

3. **Balaninus cinnamomeus** Heller. From *Ficus pubinervis* Blume (labelled *F. crassitora* Elmer) in the lower Makiling forest, March, 1921. This tree, though not of strangling habit, is monoecious.

4. **Balaninus coturnix** Heller. From the receptacles of *Ficus payapa* Blanco (labelled *F. auranticarpa*) a banyan in the lower Makiling forest, and the orange-yellow receptacles of which are covered with rather irritating, appressed whitish hairs. April, 1921.

The weevil is brownish black with an extensive pattern of golden brown scales. Reported also from Mindanao, the large southern island of the Philippine group.

5. **Balaninus cruciatus** Heller. Reared from receptacles of the banyan, *Ficus camarinensis* Merrill, May, 1921. Taken also on Mindanao (Baker). The brown color of this weevil is interrupted on the elytra by a cross-like design of golden scales.

6. **Balaninus leptoclavatus** Heller. From *Ficus indica* Linn., (Jan. 1921). Taken also on Mt. Banahao, Luzon (Baker). A rather small dark weevil with a V-like pattern of white scales at the base of the elytra, and a slim white band across the elytra at their middle length.

7. **Balaninus ornaticollis** Heller. From *Ficus payapa* (labelled *F. auranticarpa*), April, 1921. Rich brown with sides of pronotum and two proximate elytral stripes, of golden scales.

8. **Balaninus varians** Heller. From the receptacles of *Ficus calophylloides* Elmer, a very large and handsome forest banyan, April, 1921.

9. **Balaninus williamsi** Heller. From the receptacle of *Ficus palawanensis* Merrill, *payapa* Blanco, *retusa* Linn., and *forstenii* Miq., all banyans or strangling figs, January, March, April, May, 1921. The beetle is blackish marked with pale scales.

10. **Balaninus (Carponinus) axillaris** Fst.; (det. G. A. K. Marshall). Reared from receptacle ("fruits") of *Ficus hauili* Blanco, *F. nota* (Blanco) and *F. integrifolia* Elmer; adult weevils also found resting on the receptacles of *F. nota*. From low elevations to 3,000 feet in the mossy forest of Mt. Makiling. These Ficus hosts are small to moderate-sized trees of non-strangling habit that bear the male and female receptacles on separate plants, as in the common edible fig of commerce. October, 1920; January, February, March, 1921.

This weevil is a large, generally light golden brown species.

11. **Metarchus latifrons** Heller. From receptacles of *Ficus indica,* December, 1930.

A compact, rather short-snouted brown weevil that apparently pupates in mummified figs instead of entering the ground to transform.

12. **Pleurotyges tagalus** Heller. From receptacles of *Ficus* (collector number 808) related to *calophylloides* Elmer. April, 1921. Also a compact brown insect.

In addition, the weevil **Phylaitis V-alba** Pasc. (det. G. A. K. Marshall) was taken resting on the stem of the lowland *Ficus ulmifolia* Lam., a small tree whose fruits are more or less edible, April, 1921.

Mecopus hopei Boh. (det. G. A. K. Marshall), another weevil with a fig-feeding facies was also collected.

Of **Balaninus bomfordi** Fst., an Indian species, H. Maxwell-Lefroy (Indian Insect Life, p. 388, 1909) says in part, ". . . the adult eats the unopened buds of the banyan tree and feeds on the inside . . ." "The larvae are found in the fleshy receptacles of the fig, which they destroy so that the fig falls off."

A large number of other fig-feeding weevils, particularly Balaninus occur in the Philippines.

Notes on Hawaiian Lepidoptera, with Descriptions of New Species

BY O. H. SWEZEY

(Presented at the meeting of December 3, 1931)

Notes are herewith presented on a few of the Hawaiian moths whose food habits have recently been discovered, or had not been previously recorded. Some of these moths are new species and are here described. Holotypes in the collection of the Hawaiian Entomological Society; paratypes, where available, in the Bishop Museum.

Family CARADRINIDAE

Aletia ferruginea n. sp. Plate 13, Fig. 1.

Male. 48 mm. Nearly uniformly ferruginous throughout, head, palpi and thorax darker; antennae ochreous, feebly serrate. Prothoracic crest slightly tipped with whitish. Thorax clothed mostly with hair and hairlike scales. Forewings elongate-triangular, costa nearly straight, termen oblique, nearly straight, tornus evenly rounded; ferruginous, with a large triangular patch with fuscous suffusion occupying a large proportion of disc, its base a little internal from mid 3/5 of costa and apex, approaching dorsum near middle; this triangular area bordered by a suffusion of white scales. An oblique wide bar of white suffusion in cell at discocellulars with a slight narrow extension basally at dorsal end. Terminal fourth of wing with some fuscous suffusion traversed by a subterminal line of white scales parallel to the termen; along termen a slight suffusion of white scales. Cilia yellowish ferruginous. Hindwings light ferruginous with a sprinkling of fuscous scales, a fuscous discal spot and postmedian fuscous line; cilia yellowish-ferruginous; under surface of both wings ferruginous tinged, the fuscous markings showing through. Thorax beneath with light ferruginous hair; legs ferruginous, the femora hairy. Abdomen uniformly light ferruginous, apical tufts the same color.

The wing markings are strikingly different from any related Hawaiian species. The venation of forewing is peculiar in that 10 arises from angle of cell; 7, 8 and 9 are stalked, arising from 10 not far from its origin, and there is no areole.

Hab.: MAUI, Olinda (Swezey). One specimen collected on the Kula pipe-line trail, June 18, 1927.

Euxoa giffardi n. sp. Plate 13, Fig. 2.

Male. 42 mm. Head, palpi and antennae pale brownish fuscous. Antennae slightly serrate, the serrations with fasicles of cilia. Thorax brownish fuscous, paler on the front of prothoracic crest. Forewings fuscous of various shades. Costa dark fuscous with 2 white spots before middle, and 5 beyond middle. An interrupted angulated white sub-basal line from first costal white spot; a similar line from the second costal white spot. A dentate postmedial line indicated by small groups of dark fuscous scales and a few white scales at the outer angulations. Orbicular and reniform large, outlined with dark fuscous scales. Claviform dark fuscous, wide, evenly rounded outwardly. Cilia fuscous and white mixed. Hindwings pale brown, a little darker terminally, and a slight discal bar; cilia concolorous. Legs greyish fuscous, with pale apical annulations on the tarsi. Abdomen pale brown; oval tufts ochreous.

Hab.: HAWAII, Kilauea. Collected in the dry forest, August, 1920 (Giffard).

Family PHYCITIDAE

Rhynchephestia rhabdotis Hampson, Plate 13, Fig. 4.

Hampson, Ann. Mag. Nat. Hist. (10), V, p. 52, 1930.

This moth and the work of its caterpillars have been known for a long time. Dr. Perkins collected hundreds of the caterpillars from the silversword (*Argyroxiphium sandwicense macrocephalum*) in Haleakala Crater, Maui, in 1896, which, when brought to Honolulu, failed to produce more than one or two moths. The writer collected a few of the larvae in July, 1907. Again, only one or two moths were produced, and rather indifferent specimens. In 1931 a specimen of the silversword plant from Haleakala Crater was sent in by National Park Superintendent Mr. E. P. Leavitt, and among other insects found on the plant were quite a number of caterpillars, and from these two more moths were reared. Finally Mr. Owen Bryant, of Banff, Canada, while on vacation here, spent some time collecting on Haleakala. From caterpillars collected and sent down by him, 9 moths were obtained in fairly good condition. The description by Hampson was from 2 male specimens ascribed to Terry as collector, the locality being merely "Maui," no date, and the "larva on Argyroxiphium." We are not fully aware of the circumstances of the collection of these specimens or how they reached the British Museum. Presumably they were from Haleakala Crater, as the moth is not yet known from anywhere else, or from any other plant except the silversword, and

this plant is very restricted in distribution. Besides the Haleakala station, it was formerly known on Mauna Kea, Hawaii, but is now extinct there. Of recent years it has been found on Mauna Loa, Hawaii, but there is no report of the moth or larvae infesting the plants there.

The larvae feed in the flower heads, destroying the seeds. In the seasons when there are no flowers they feed in the stem and among or at the bases of the leaves which are densely crowded together. The larvae are subject to a fungus which kills a large proportion of them. That is the main reason why so very few moths have been obtained from the larvae that have been brought down for rearing.

Homoeosoma amphibola Meyrick.

Meyrick, Fauna Hawaiiensis, I, p. 197, Pl. V, Fig. 12, 1899.

This moth was originally collected on the high plateau of Kauai above Waimea and at Kaholuamano by Perkins. Later collections were made by Kusche in 1919 and 1920 at Kokee, Kaholuamano and Waialeale. The food plant and habits were not known until the writer discovered in 1925 that it was attached to *Wilkesia gymnoxiphium*, which is an endemic shrub related to the silversword, and occurring only on Kauai, where the writer has observed it to be common in several localities, on dry slopes in the forested region at Kokee, Halemanu, Nualolo and Milolii, also in one place in the scrub near the road only a little above the upper cane fields of Kekaha Sugar Company. This plant blooms in June and July, producing a large panicle of flower heads; after ripening the seeds the whole plant dies. The larvae of *amphibola* feed on the flowers but do not injure the seeds. The larvae are so numerous that nearly every flower head is attacked. When there are no more flowers to feed on, the nearly grown larvae bore into the stem and feed on the pith, which occupies a considerable portion of the stem. The cocoons are formed within the hollowed-out stem. Some of the larvae shortly transform to pupae and then adult moths; but others remain as larvae for a long time within the cocoon and probably are able thus to carry over till the next blossoming season. None of the plants that have not reached the blossoming stage has been found attacked, nor has any other kind of plant been found attacked by this moth.

Many of the larvae die from fungus. Quite a number are parasitized by a species of Sierola.

Family XYLORYCTIDAE

Thyrocopa peleana n. sp. Plate 13, Fig. 3.

Male, female. 25-41 mm. Head and palpi white; antennae white at base, infuscated outwardly. Thorax white. Forewings nearly pure white with scattered fuscous scales, a few of which are clustered irregularly in two spots obliquely placed in cell, and two spots vertically placed at end of cell; in one male these spots are more conspicuous and the costa is black at the base. Underside suffused with light brown, cilia white. Hindwings and cilia white. Legs white, anterior femora and tibia infuscated. Abdomen white, apical tufts of male slightly ochreous tinged.

Very similar to *T. sapindiella* Sw., but twice as large.

Hab.: OAHU, Waipio ridge. 3 males and 3 females reared from caterpillars in burrows of *Nesithmysus bridwelli* Perkins, in Pelea trees, October 9, 1927 (Swezey). The larvae feed on decaying wood in the burrows, and also on the bark around the entrance, spinning a sheet of web to cover the place where feeding has taken place.

Family DIPLOSARIDAE

Aphthonetus sideroxyloni n. sp. Plate 13, Fig. 7.

Male and female. 20-23 mm. Antennae ochreous, basal segment brownish. Palpi ochreous, brownish externally. Head ochreous in front, sprinkled with brownish on vertex. Thorax brown, apex ochreous, patagia tipped with ochreous. Forewings mostly dark brown, with a whitish ochreous streak all along dorsum, this streak wider at base and expanding on termen to near apex, the boundary between brown and ochreous areas irregular. Basal half of costa and apical third has ochreous scales mixed with the brown. Near middle of wing an ill-defined circular spot with brown center; beyond this two similar semicircular spots with paler centers and a dark brown spot between them. Several raised tufts of brown scales. Cilia whitish ochreous, with a few brownish scales mixed in upper part of terminal cilia. Hindwings and cilia whitish ochreous. Abdomen whitish ochreous. Fore and mid legs with tibia and tarsi dark brown, femora paler and apex of tarsal joints pale. Hind legs whitish ochreous.

Related to *A. fluctuosa* Walsm., but the latter does not have the dorsum pale throughout.

Hab.: OAHU. Described from 9 specimens reared from larvae on leaves of *Sideroxylon sandwicense*, collected May 28, 1929, on ridge above Puu Peahinaia, Koolau Mts. The larvae fed on the under surface of the leaf protected by a frass-covered web.

Hyposmocoma latiflua Meyrick. Plate 13, Fig. 6.
Meyrick, Exotic Microlepidoptera, I, p. 344, 1915.

This species was described from a single specimen collected by Perkins in the Koolau Mts., Oahu, about 1900 or 1901. It was not rediscovered until 26 specimens were reared from larvae found by the writer feeding on leaves of *Pittosporum cauliflorum* on the ridge leading up to Puu Kalena, Waianae Mts., Oahu, December 29, 1929. The larvae were feeding singly on the under surface of the leaves beneath a frass-covered web. The upper surface of the epidermis was left intact and showed as a dead spot in the leaf. Pupation took place in a cocoon in the same place where larva fed. The pupa is brown, about 5 mm. long; the wing and antenna sheaths extend to apex of 7th abdominal segment; cremaster rounded obtuse, with 8 erect hooked bristles on dorsal part.

Family HYPONOMEUTIDAE

Mapsidius charpentierii n. sp. Plate 13, Fig. 5.

Female. 21 to 24 mm. Antennae cinereous, basal joint white. Palpi white. Head and thorax white with a sprinkling of black scales. Forewings white with numerous angulated black spots and a sprinkling of black scales; cilia at apex and termen white, brownish gray on dorsum. Hindwings brownish gray, cilia concolorous except at apex where they are tipped with white. Abdomen brownish gray with apical margins of segments white; white ventrally. Legs white, tibia and tarsi banded with black.

Male similar to female but hind wings and abdomen darker.

Similar to *auspicata* Walsm., but of larger size, and the black marks on the forewings (as shown by the figure) are more distinct and angulated. The cocoon is different, also. It is elongate spindle-shaped, densely made of white silk, placed on underside of leaf and beneath a thin lacework of silk which has several large circular meshes. This is similar to the way the cocoon of *M. quadridentata* is constructed, whereas the cocoon of *auspicata* is broad spindle-shaped beneath a closely-woven layer of white silk.

Pupa 10 mm., dark brown, lighter on the wing sheaths, which extend as far as the apex of 6th abdominal segment. Apical margin of abdominal segments with a raised rim. Spiracles of abdominal segments raised. Cremaster obtuse.

Hab.: OAHU. Described from three specimens reared from caterpillars and cocoons collected on leaves of *Charpentiera obovata*, in Mohiakea Valley, Waianae Mts., January 3, 1932, and one from Haleauau Valley, April 19, 1931.

Family TORTRICIDAE

Panaphelix asteliana n. sp. Plate 13, Fig. 8.

Male and female. 24-29 mm. Nearly uniformly light fuscous brown. Head and thorax pale brown to ochreous, palpi pale brown; antennae ochreous, the pectinations of antennae in male pale brown. Thorax with two parallel longitudinal ochreous lines, patagia ochreous. Forewings fuscous brown with ochreous lines on the veins, a roundish dark fuscous spot at end of cell; cilia ochreous, mixed with brown at base. Hindwings pale brownish ochreous, more brownish at apex and termen; cilia ochreous, mixed with brown at base. Legs ochreous, fore and mid tibiae and tarsi fuscous brown. Abdomen pale fuscous brown, apical tufts of male ochreous.

Distinct by its brownish coloration, and the lines of ochreous on the veins of forewings.

Hab.: Waianae Mts., OAHU. One male and one female reared from *Astelia veratroides*, January 22, 1929, one female February 9, 1930, all on the ridge leading up to the summit of Mt. Kaala at about 3,200 feet elevation (Swezey); one male captured at same place September 14, 1930 (Williams); two males captured near summit of Puu Kalena, April 19, 1931 (Swezey). Larvae have been brought in at other times from these places, but failed to mature.

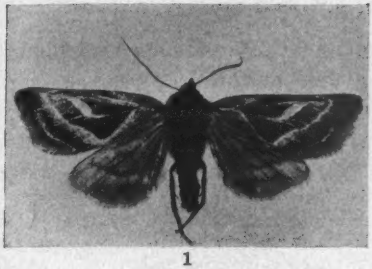
The larva is greenish with some fuscous marks on head and cervical shield. It feeds beneath web on apical part of the Astelia leaf. The leaf is partially eaten on a transverse line on lower side about 6 inches to a foot from the apex. The apical portion then bends down and is the part on which the larva feeds, eating off the under surface and leaving the extreme apical portion rolled and spun together for a retreat which eventually becomes filled with the frass.

The pupa is brown, about 15 mm. in length. The wing and leg sheaths reach the apex of the 3rd abdominal segment; the abdominal segments have two dorsal transverse rows of short spines; near the base of each abdominal segment 1 to 7 is a pair of circular dorsal pits wide apart; cremaster somewhat extended, bluntly conical with 8 hooked bristles, 4 on apical margin and 2 on each side.

Explanation of Plate 13

(All slightly enlarged)

FIG. 1. *Aletia ferruginea.*
FIG. 2. *Euxoa giffardi.*
FIG. 3. *Thyrocopa peleana.*
FIG. 4. *Rhynchephestia rhabdotis.*
FIG. 5. *Mapsidius charpentierii.*
FIG. 6. *Hyposmocoma latiflua.*
FIG. 7. *Aphthonetus sideroxyloni.*
FIG. 8. *Panaphelix asteliana.*



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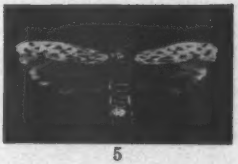

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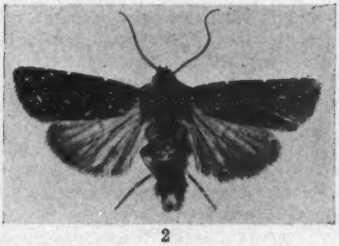

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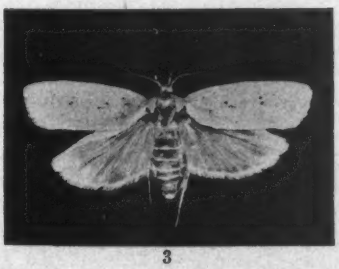

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8

Swezey. **Hawaiian Lepidoptera**

Exallonyx philonthiphagus, a New Proctotrypid Wasp in Hawaii, and Its Host

BY FRANCIS X. WILLIAMS

Exallonyx philonthiphagus n. sp. (Plate 14, figs. 1-4.)

♀. Length to end of ovipositor 5.10 mm. Black; tegulae yellowish brown, mandibles brown, dark at base and near apex, labrum, legs, except apex of femora and of coxae, and trochanters in part, light brown, femora otherwise rather dark brown; antennae dark brown (appearing paler in a specimen preserved in spirits), scape darkest, pedicel and first flagellar joint palest; stigma smoky brown. Head, from above, subquadrate, somewhat wider than long; smooth and polished, with pale pile, eyes sparsely pilose, distant from the posterior margin of the head by about their longer diameter, ocelli forming a rather low triangle, malar space about equal to shorter diameter of eye; frons carinate between the insertion of the antennae, anterior margin of clypeus very slightly emarginate, mandibles simple, third joint of labial palpi broadened and obliquely subtruncate at apex; antennae rather stout, a very little longer than head + thorax; 13-jointed, first two flagellar joints subequal, the first about twice as long as its greatest diameter, subsequent joints to 13th, becoming shorter and more rounded, 13th joint subacuminate at tip and at least half again as long as the 12th or penultimate. Thorax: neck transversely carinulate above and at sides, mesothorax narrowed in front, the sides concave; scutum smooth and polished, impression at base of scutellum deep; metanotum foveate; pro- and mesopleurae smooth and polished, posterior margin of mesopleurae foveate; metapleurae strongly reticulate. Propodeum: a broad smooth space on each side of the median carina, passing over into strongly reticulate sculpture behind and at the sides; femora stout, the anterior ones particularly so, longer metatibial spur less than half as long as the metatarsus. Wings clear; costal, subcostal and submarginal veins brown; stigma brown; marginal cell a little more than half as long as stigma, other venation represented by glassy folds or ridges. Abdomen: petiole, above, broader than long, its basal angles prominent, the apical end rounded-angulate; sculpture rather coarse and irregular; beneath transversely wrinkled except apically, where it is longitudinally parallel-grooved; longitudinal grooves at base of abdomen above, increasing in length mesially. Ovipositor finely longitudinally aciculate, hardly as long as the hind metatarsus.

Type, ♀, and 1 ♀ paratype (lacking part of abdomen and wings); and a ♂ and ♀ pupa, all in the collection of the Experiment Station, Hawaiian Sugar Planters' Association. A ♀ also deposited with Professor C. T. Brues, Department of Entomology, Harvard University. All were reared from larvae of the staphylinid beetle *Philonthus turbidus* Erichson, secured at Nauhi, Hawaii, 5,250 feet elevation, October, 1931. This wasp, judging from Ashmead's table and description (Monograph of the North

American Proctotrypidae, Bull. 45, U. S. National Museum, p. 335, and pp. 343-344, 1893), and from Brues' table (Jour. New York Entom. Soc., XXVII, pp. 9-11, 1919), is certainly closely related to *Exallonyx quadriceps* (Ashm.) from the Eastern United States and which is apparently a smaller species with slightly paler appendages; it seems also related to the European *Exallonyx ater* (Nees), (see Morley, C. A Synopsis of British Proctotrypidae (Oxyura); The Entomologist, 55, 1922, on pp. 159-160, and 183).

On September 30, 1931, while studying the insects of decayed tree trunks with Mr. O. H. Swezey, at Nauhi Forest Nursery, on the moist slopes of Mauna Kea, Hawaii, at an elevation of 5,250 feet, 6 larvae of the staphylinid beetle *Philonthus turbidus*, each with an Exallonyx wasp pupa protruding from its abdomen, were found. The fallen trunk of an *Acacia koa* Gray, from which 5 of the specimens were secured, was much decayed and its hollowed upper surface contained soil-like material besides the disintegrated wood. A near-by log yielded the sixth Exallonyx. In some cases, at least, the parasitized Philonthus larva lay in a cell. Five of these bore a female wasp pupa, each of which protruded for half its length or more from the venter of its host's abdomen and towards which it could bend the body. The single male pupa protruded somewhat less than one-third its length from the host. The one bearing the male pupa (Fig. 4) had evidently been quite near pupation at the time of attack by the wasp, for its head capsule was split above and below, and the pro- and mesonotum were also cleft, as occurs when the skin is about to be shed to release the pupa. A second parasitized Philonthus, likewise with the thoracic plates divided, had the posterior portion of the body hollowed out by the wasp grub, while the anterior portion, little eaten of, enclosed head and thorax, already more or less chitinized, of the next or pupal stage of development. Other parasitized larvae did not show these signs of moulting, but all appeared to have reached their maximum growth. It seems reasonable to suppose, therefore, that *Exallonyx philonthiphagus* attacks only those Philonthus larvae that, because of nearness to the quiescent or pupal stage, are comparatively helpless; the feeding Philonthus larva is active, carnivorous, and armed with sickle-like jaws and would then seem too strong an antagonist. It is evident that the

Exallonyx larva feeds within the body of its host and when the time for pupation is at hand breaks through the venter and pupates partly extruded—as figured. Here one sees that in the female pupa, the antennae are stretched along the underside of the body (Fig. 1), while in the male they are bent back on the head with somewhat of a ram's horns effect.

The single male pupa, showing signs of dissolution, was preserved in alcohol together with a female pupa. The remaining 4 Exallonyx pupae successfully transformed into shining black wasps about 5 millimeters long and with the legs largely brownish. Unfortunately, 2 of these wasps were enclosed in a vial containing a *Philonthus turbidus* pupa, that, hatching into a beetle, mutilated and partly devoured its wasp foes. The pupa of this beetle is comparatively stout, yellowish brown, well chitinized and with the appendages immovable.

Philonthus turbidus (Erichson, W. F., Genera et Species Staphylinorum, Berlin, p. 484, 1839-1840), is widespread in the Hawaiian Islands, and M. Bernhauer and K. Schubert, in W. Junk's Catalog of Coleoptera, Staphylindae, p. 358, 1914, give its world distribution as: Canaries, Madagascar, Hawaii, Morocco, Egypt, Maderia, Syria, and South Russia.

Few hosts of the genus Exallonyx appear to be known. In Great Britain, F. W. Frohawk bred 9 individuals of *E. ater* (Nees) from a single larva of *Creophlius maxillosus* (Lec.), a large stout and common staphylinid beetle. The wasps issued from pupae that protruded from the underside of the defunct beetle larva. (Frohawk, *Proctotrypes ater* from larva of *Creophilus maxillosus,* The Entomologist, p. 225, 1886, Fig.). Sharp, in Cambridge Natural History of Insects V, p. 535, 1895, shows in Fig. 352 the "Pupation of *Proctotrypes* sp. in body of a beetle larva," said beetle larva greatly resembling one of the Stapylinidae, and from the underside of which over a dozen of the wasp pupae are protruding. In genera related to Exallonyx, the North American *Cryptoserphus obsoletus* (Say) has been reared by Prof. Comstock in 1879 from the larva of *Stelidota strigosa* (Gyll.), a beetle of the family Nitidulidae (See Ashmead Bull. 45, U. S. Nat. Mus., p. 340, 1893); while the European *Paracodrus apterogynus* (Haliday) has been bred by K. Zolk from the Larva of *Agriotes obscurus* L., an elaterid beetle (Zur Biologie von *Paracodrus*

apterogynus Halid. Tartu Ülikooli Ent-katsejaama teadaanded Dorpat No. 5, 1924, 10 pp., 6 figs.). It seems probable that this was the wasp species "the destroyer of the wireworm" bred by Wm. Kirby and so recorded in 1859, and by Curtis. (See Morley, The Entomologist, p. 55, 1922.)

Several species of the genus Proctotrypes in Europe are known to parasitize the larvae of carabid and staphylinid beetles and of certain diptera, while *P. calcar* Haliday has been reared by Newman from the centipede *Lithobius forficatus*, 21 of the wasp pupae protruding from its neutral side (Newman, E., The Entomologist, pp. 342-344, 1867). For the classification and data on the biology of European Proctotrypidae, see Claude Morley (A Synopsis of British Proctotrypidae (Oxyura), The Entomologist, 55, pp. 1-3, 59-60, 82-83, 108-110, 132-135, 157-161, and 182-186).

H. Maxwell-Lefroy, Indian Insect Life, p. 168, 1909, states that an Indian species of Proctotrypidae was reared from a beetle larva.

Proctotrypes hawaiiensis (Ashmead, Fauna Hawaiiensis, I, Pt. 3, pp. 294-295, 1901), a wasp with the head transverse, is the only other proctotrypid recorded from the Hawaiian Islands, where it has been taken by Dr. R. C. L. Perkins and others at suitable elevations in the mountains.

EXPLANATION OF PLATE 14

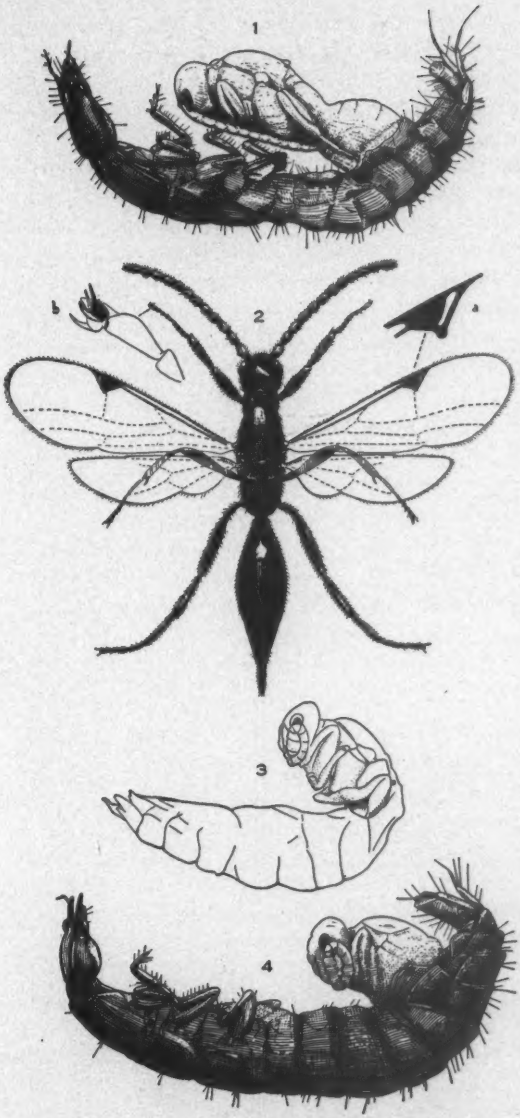
(All figures enlarged 11 diameters, except 2a and 2b highly enlarged)

1. Larva of the staphylinid beetle, *Philonthus turbidus;* with the female pupa of the wasp *Exallonyx philonthiphagus* protruding from the underside of its abdomen.

2. Adult wasp, *Exallonyx philonthiphagus* type; female; a, stigma and marginal cell of wing; b, last two tarsal joints and claws of foreleg of paratype.

3. Male pupa of the wasp *Exallonyx philonthiphagus* dissected from body of its host, *Philonthus turbidus.*

4. Larva of *Philonthus turbidus* showing male pupa, of fig. 3, of the wasp in position.



Williams. **Exallonyx philonthiphagus**

Records of Immigrant Insects for 1931

BY THE EDITOR

The following immigrant insects are recorded in this issue for the first time as occurring in Hawaii. Some of them have been previously known to occur here, but had not been identified, and their names are now recorded for the first time. Those marked with an asterisk were observed for the first time in 1931. For details of records, etc., refer to the pages given.

	PAGE
**Megamelus proserpina* Kirkaldy (Hom.)	1
**Pesudococcus citricolus* Green (Hom.)	2
**Galleria mellonella* (Linn.) (Lep.)	4
Psocathropos lachlani Ribaga (Psocidae)	8
Psoquilla marginepunctata Hag. (Psocidae)	8
Enochrus nebulosus (Say) (Col.)	16
**Tachysphex fusus* Fox (Hym.)	17
**Chalybion caeruleum* (Linn.) (Hym.)	17
Telmatoscopus albipunctatus (Will.) (Diptera)	18
**Monocrepidius* sp. (Col.)	23
Cephennium sp. (Col.)	24
Diorymerellus laevimargo Champ. (Col.)	28
Cephalonomia tarsalis (Ashm.) (Hym.)	31